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Risk Analysis Applied to Commodity Speculation.

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ABSTRACT

RISK ANALYSIS APPLIED TO COMMODITY SPECULATION

An approach to investment decision-making applied specifically to wheat futures, but which may be generalized to almost all investments, is the subject of this dissertation. The method adopted is based on Bayes Theorem and provides probability values (posterior probabilities) for the rates of return (States of Nature) on a wheat option. A section of the paper is devoted to estimating the inherent risk of a contract by the standard deviation of daily price changes and the estimation of the rate of return available (ex post) from several random investment programs.

A frequency distribution for the rates of return developed through a random investment program of daily price data involving 4700 iterations establishes the prior probabilities of Bayes Theorem. The data bank contains the daily high, low, and close prices for the calendar years 1957-1962 and 1967-1968. The conditional probabilities are based on sampling information of variables assumed to directly effect the price of wheat. In order to establish these critical variables correlations with daily wheat prices were run on the following factors: (1) weather conditions, (2) the political climate, (3) direct demand/supply effecting factors, and (4) announcements by the United States Department of Agriculture concerning wheat production. The conditional probabilities are weighted by their prior probabilities in order to form a posterior probability distribu-

tion of the rates of return. The investor runs a continuous search of the random variables and adjusts his position in the futures market according to the posterior probability distribution.

Conclusions of the investigation are:

1. Bayes Theorem can be applied to the wheat futures market to provide a quantitative answer to a highly subjective area. The study provides the empirical data necessary for computing prior and conditional probabilities.

2. The expected rate of return over the long run from speculating in the futures market is approximately zero.

3. The rates of return on the wheat futures market have an extremely wide distribution. The distribution is bimodal with the peak of each modal group falling into its respective rate of return class of -100 to -200 per cent and +100 to +200 per cent.

4. It was found that a wheat option has greater price variation during June, July, and August than in other months.

5. Filter rules based on ex post data of price variation limited an investor's downside risk and increased his profit potential when compared to a random buy-hold policy. The filter rules worked equally well for short or long positions.

6. A correlation of daily price changes with news items concerning the demand and supply of wheat produced low statistical correlations.

7. The flat $500 margin required by brokerage houses on a wheat contract should be revised to reflect the price variation for the particular calendar purchase month and the particular option purchased.

CHAPTER I

INTRODUCTION

The Area in Perspective

The Investment Decision. The investment decision is a matter of selection among available alternatives. The decision-maker must: (1) define the alternatives relevant to his problem, (2) develop the criteria for assigning values to the alternatives, and (3) rank the alternatives by these assigned values. Since an investor cannot possibly select objectively from all types of investments, he must develop constraints for the population of all investment opportunities. The investor will then seek to maximize his wealth subject to the constraints of his model. In order for any model to be empirically valid, estimates of the critical variables (those variables which have the greatest weight in determining the outcome) must be obtained. For the project under study, data are available to provide these critical variables and these variables are incorporated in a model.

The value of the model can be established by comparing its gains with the return expected from an investment of similar risk. The calculation of the latter return could be of a theoretical nature involving a utility function or empirically determined through a random selection of investments or by comparison to an index.

The cost of constructing the model and providing the relevant data must be established. For some decisions, the expense of calculating the opportunity cost involves the establishment of the equivalent risk opportunities available for investment. As risk increases more information is required. The increase in necessary data is a result of the greater uncertainty attached to the future position of such an investment. Usually this additional information is less accessible and, hence, more costly to obtain. The closer the resemblance between the model and the real situation, the greater its value as a forecasting device. The dollar value of the model depends on the profit that can be derived through its use, with the cost limitation being the gain attributed to the forecast.

Evaluating the Risk-Return Package. The decision-maker subjectively determines investment opportunities suitable to his needs. These investment opportunities are then ranked by their opportunity costs which are defined in terms of their expected values and variances.

In the aggregate, investors also subjectively determine the risk associated with an investment. This risk can be expressed in the form of a probability distribution of the anticipated rate of return from the investment. "The market value of traded securities and investments reflects a composite appraisal of earning power and risk . . . . Since investors compositely exhibit risk aversion market competition reduces value as the expectation of earnings fluctuations increase."[1]

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[1]Charles L. Hubbard and Clark A. Hawkins, Theory of Valuation, International Textbook Company, Scranton, Pennsylvania, 1969, p. 52.

As investors in the aggregate perceive that a particular class of investments has changed in risk, the type of investors in that risk class also changes. As the investment becomes riskier (the probability distribution associated with its return has an increasing dispersion) the more conservative members of that risk class dispose of their holdings. These shares are then purchased by investors that can assume more risk. With each differing risk, the investor has a shift in his expected value and a change in variance. The investor's decision is optimal when the selection of a risk class involves the highest expected value for that degree of variance.[2] The risk class is determined by the dispersion associated with the earnings of that investment. As the investor increases the variance associated with his expectations, the expected value of his investment should shift to the right.

The Perception of Fundamental Information. Fundamental information is vital to this shift of investor risk class (i.e., from risk averter to risk seeker). What is also vital is the perception of fundamental information by each investor risk class. The redundancy of information of a particular nature is necessary to reinforce behavior patterns. For instance, a risk seeker will act on the first introduction of investment affecting information, whereas a risk-averter will need several repetitions of the same type of information before responding.[3]

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[2]Harry Markowitz, "Portfolio Selection," in Frontiers of Investment Analysis, E. Bruce Fredrikson, editor, International Textbook Company, Scranton, Pennsylvania, 1965.

[3]Jack J. Hayden, What Makes You a Winner or a Loser in the Stock and Commodity Markets? Investors Intelligence, Larchmont, New York, 1967.

Fundamental information is not generated according to a discernible pattern. News makes its appearance randomly, and decisions are based on randomly generated news. This news can be of a general economic nature or of a specific nature with each bit of news being weighted in the decision-making process according to its value to the investor. Major factors to consider in the evaluation of a corporate security are the general economy, the particular industry, and the company itself. The current status of these segments is compared to the concept of normalcy for these segments. But, how does an investor define this normalcy? ". . . since the degree of risk-aversion of any k-class of investors at any time is a function of the general optimism, it is also a random variable, but its expected value is an inherent attribute, a parameter, peculiar to investors of that class."[4] From a psychological standpoint, an investor's risk aversion is determined by the effect of a given piece of information on his decision to buy, sell, or hold. An individual averse to risk will sell his securities on the first introduction of pessimistic information concerning his securities. Such an individual falls into the category of investors appropriately called "weak hands" in the jargon of Wall Street.

General Risk Classifications. Every investment is composed of several forms of risk: (1) pure risk, (2) business risk, (3) financial risk, (4) inflation risk, (5) political risk, and (6) market (psychological) risk. The importance of each form of risk to the investment in question must be determined and weighted. These weights will determine the study necessary for each of the above risks in relation to a

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[4] *Ibid.*, p. 52.

particular investment (P). A treasury bill due tomorrow is subject mostly to the pure interest risk, whereas a common stock issue of an untried company is subject to all six.

Statement of the Problem

Risk-Return Analysis. Two areas of risk analysis are explored. The first area involves a risk-return analysis while the second area involves forecasting commodity prices. In the section, Evaluating the Risk-Return Package, the discussion centered on the existence of a risk-return relationship whereby the return from a P increased as its corresponding risk increased. This risk-return function can be plotted as a continuous curve. There are no gaps (steps) in this curve. As the return from a project changes, the investor expects a corresponding change in the risk associated with the investment.

Thus it follows that as the investor decides to assume more risk, he anticipates an increase in his return. This continuous curve is a function of a highly competitive market. Whenever this market is not in equilibrium (the course is not smooth), a change in the demand/supply relationship will correct the disparity. This change in relationship occurs because of the opportunity for additional profit. Such a disequilibrium is known as an arbitrage opportunity and investors will change their positions in the market until this source of profit has been eliminated.

If there exists a constant price disparity which is more (less) than the risk-return package would indicate, the theoretical assumptions of a market correcting for an arbitrage situation would be erroneous. This paper establishes the risk-return relationships that exist in the commodity grain market and searches for areas where the risk-return function is not continuous over the long run.

Certainty-Equivalent. There exists a certainty-equivalent in which an investor will trade-off an uncertain return for a certainty. Thus, an investor will trade his expected return from a speculative growth company for a government bond with some specified yield. An example of an almost riskless investment is a treasury bill due tomorrow. This yield could be used as the risk-free rate. Its expected yield is a function of the probability of receipt of the interest and the yield of the bill. This calculation can be expressed as:

$E(X) = \sum_{i=1} X_i P(X_i)$; where E(X) is the expected value of the X's, X is the anticipated interest rate, and $P(X_i)$ is the probability of a particular X value. Then a treasury bill yielding 6% with a 100% probability of receipt would have an E(X) value of 6%. Should the investment have an uncertain return, we could apply the above formula to the distribution of X values.

Another statistic to be employed is a risk measure. The measure will be the coefficient of variation (the standard deviation divided by the expected value). These statistics can then be used in the development of an index for decision-making in the commodity market.

Risk-Aversion and a Type II Error. An investor can explicitly define the optimal decisions he would make from a fundamental standpoint. Yet the investor will adopt a decision that is in apparent conflict with this "correct" decision. This difference is due to the assumption of additional risk for that P. As an investor enters into a project with a greater expected return he accepts a greater likelihood of making a Type II error (accepting a false hypothesis) if he applies the distribution associated with the lower risk. As the risk increases an investor should discover variables farther and farther from the mean value. The risk-averter has a very small variance associated with his expectations. His null hypothesis would be that his subjective curve of the return from a P is the true curve for that risk class. The alternative hypothesis would be that his estimate of the true curve is not correct.

As the risk-averter is exposed to more and more information in regard to his investment he slowly changes his original concepts of risk. During a bull market, news is continually received of a favorable nature. This news reinforces the prior news which was also favorable. The risk-averter re-evaluates his present position and assumes he can absorb investments of greater risk as time passes. With such a decision he is increasing his chance of a Type II error. He will be assuming that his curve is the correct curve, a curve that matches the market curve, when in reality it is not.

Forecasting Commodity Prices. The second area involves developing a theoretical framework for analyzing and forecasting commodity price changes. These changes are dependent on changes of certain critical variables. A multiple regression analysis is used to establish the importance of a number of variables. These variables are used to establish on an *ex post* basis the expected value of commodity price changes given the occurrence of these variables. These critical variables and their probability distributions derived on an *ex post* basis are used to develop *ex ante* yields.

Significance of the Study

This study draws upon some important tools and thoughts from other disciplines. These tools and thoughts are synthesized into an approach to commodity speculation in particular and to the area of decision-making in general.

Learning theory draws from the disciplines of psychology and marketing to show investor response to changing market conditions. Probability theory contributes methods for portraying risk and value. Thomas Bayes contributed over two hundred years ago to this application of decision-making theory, but recently widespread use has been made of his contribution. Economic theory draws these variables together to provide a basis for estimating the future of an investment.

With the aid of these disciplines, the study seeks out variables which are significant to the decision involved in commodity speculation. Weights are assigned to these variables based on historical data. This study provides the investor with a heuristic quantitative approach to commodity decision-making.

Summary

This paper draws together several disciplines: psychology, probability theory, and economics in the development of a method for speculating in the commodity grain market. The decision to take a long or short position in the commodity market is based on changes in variables that the decision-maker feels are most significant to changes in commodity prices. These variables are known as the critical variables of the study. A regression analysis defines the explanatory relationship of the selected variables. These critical variables form the "states of nature" and have a likelihood of occurrence established on an *ex post* basis. These *ex post* probability estimates will be used in constructing a matrix for *ex ante* forecasting of commodity prices.

In order to develop strategies, a commodity selection plan must be developed. Commodities will be divided into risk classes through the calculation of the standard error of the mean based on daily price in each month for each contract. The study suggests several strategies that a commodity speculator might reasonably adopt and presents the expected outcome for each strategy given a particular "state of nature."

CHAPTER II

RELATED LITERATURE

Investment Decision Theory

David B. Hertz has a rather general article that sets the stage for the application of risk to an investment. He advocates the use of a probability distribution of the predicted rates of return associated with a particular investment rather than using the expected rate of return [E(X)]. Because E(X) represents only one point on a continuous curve, the investor should be aware of the distribution of values associated with this summary E(X). The less certain the investor is about the E(X) the more necessary it becomes for him to use a probability distribution for his decision.[1]

In the determination of the type of probability distribution to apply to the data, Soldofsky and Bederman determined the frequency distribution of annual yields of a composite index for the Dow Jones Industrial and Utility Index. The fit to a normal curve for the years 1930 to 1966 is almost perfect. Using Moody's 125 Industrials, these same authors calculated the standard deviation, geometric mean, and the coefficient of variation. The findings show a ". . . generally progressive narrowing of the variation among the yields for

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[1]David B. Hertz, "Risk Analysis in Capital Investment," *Harvard Business Review*, Vol. XLII, January-February, 1964, pp. 95-106.

successively longer holding periods. The longer the holding period, the less important the starting points tend to become in terms of both the average yields and the dispersion of yields."[2]

Peterson develops a risk-return package from the standpoint of a firm

> . . . if the firm chooses an investment-financing plan with an associated risk-return package generating the largest possible market value for the stock, the existing owners may react in either of two ways. If they find this risk-return package consistent with their own utility objectives, they will presumably continue to hold stock worth at least as much as any other acceptable risk-return package their firm could achieve. Or, if they find some other available risk-return package more desirable, they can dispose of their holdings in order to purchase that package and realize the largest possible proceeds their firm could have generated for them.[3]

Another group of studies involves the hypothesis of efficient sets as defined in the Markowitz/Tobin/Lintner form. These studies concentrate on the classification of risks rather than in the development of efficient portfolios.

Two articles that are parallel to the project under study are by William F. Sharpe, "Risk-Aversion in the Stock Market: Some Empirical Evidence," and Eugene F. Brigham, "An Analysis of Convertible Debentures." Sharpe tests the hypothesis that "Market prices of capital assets will adjust so that the predicted risk of each efficient portfolio's rate of return is linearly related to its predicted expected

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[2]Robert M. Soldofsky and Roger Biderman, "Yield-Risk Measurement of the Performance of Common Stocks," Journal of Financial and Quantitative Analysis, March 1968, Vol. III, p. 70.

[3]D. E. Peterson, A Quantitative Framework for Financial Management, Richard D. Irwin, Inc., Homewood, Illinois, 1969, p. 25.

rate of return."[4] The expected value of a distribution (E_i), then, is the pure interest rate (p) plus a risk premium. $E_i = p + b_i$. Sharpe follows the procedure of: (1) calculating the average rate of return of 34 open-end mutual funds over a ten year time period and using this average as an estimate of the efficient portfolio's expected rate of return, (2) calculating the standard deviation for the same group as an estimate of its predicted risk, and (3) computing the correlation coefficient for the group.

The result of the study shows, "The Correlation coefficient between σ and E is + .836, highly significant and consistent with the assumption of risk aversion."[5] Investors, under the assumptions of this article, have allowed for a risk premium that is linearly related to the predicted expected rate of return. Of course, as mentioned by Sharpe, the basic assumption of an investor being able to borrow all he needs at the pure interest rate certainly limits the validity of the study.

Eugene Brigham limited the decision variables in his study of convertible bonds to two, the coupon interest rate and the conversion ratio. There is an infinite number of combinations of these decision variables in the attempt to construct the investor's ex ante yield on convertible bonds.

The state variables are: (1) issue price of the bond, (2) terminal value at which the firm is expected to force conversion, (3) current market price of the shares, and (4) the expected growth rates of share

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[4]William F. Sharpe, "Risk-Aversion in the Stock Market: Some Empirical Evidence," in Basic Financial Management: Selected Readings, J. Fred Weston and Donald H. Woods, editors, Wadsworth Publishing Co., Inc., Belmont, California, 1967, p. 393.

[5]Ibid., 395.

prices. In order to compute *ex ante* yield on a convertible bond, Brigham works sequentially through two equations using the expected value of the decision variables as an input. These equations may be used

> . . . to gain insights into the way in which different combinations of i (coupon interest rate) and P_c (conversion price) interact with the predetermined variables to influence K* (the *ex ante* yield). This, in turn, provides insights into rational trade-offs between the two decision variables.[6]

Nimrod and Bower mention in a 1967 article that they were unaware of any previous studies applying econometric models used with computers for commodity futures speculation. Their model seeks a gain through predicting " . . . the spot price for some future month and to trade on the basis of any large unexplained difference between this prediction and the current price of futures for that month."[7] The spot price for hogs was considered to be " . . . simultaneously determined but supply, income and consumer preference were viewed as exogenous variables."[8]

A regression equation is first used with seasonally-adjusted data without success. The regression employs data from the month of August in each of 20 years. This equation was $P_H = a + bP_S + cI + dH + eB + U$, where a, b, c, d, e are the regression coefficients, and

P_S = Number of steers slaughtered in the month of the spot price

I = pounds of pork in cold storage

H = number of hogs slaughtered

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[6]Eugene F. Brigham, "An Analysis of Convertible Debentures," in Keith B. Johnson and Donald E. Fischer, editors, *Readings in Contemporary Financial Management*, Scott, Foresman and Company, 1969, p. 335.

[7]Vance L. Nimrod and Richard S. Bower, "Commodities and Computers," *Journal of Financial and Quantitative Analysis*, March, 1967, p. 61-73.

[8]*Ibid.*, p. 63.

B = Spring pig crop

U = influence of other excluded but randomly changing variables on the price of August hogs.

The values for the state variables are on freehand projections of past data. This system is employed since the authors commented that security analysts felt such variables could not be reduced to mathematical expressions.[9] It is the intent of the present paper to reduce these variables to mathematical expressions that may be used for forecasting.

Psychology

In the last fifteen years numerous studies have produced high correlations between independent and dependent variables in regard to stock valuation models. Stock valuation models are a never ending source of study as each researcher tries to develop a correlation that will be both theoretically and financially fruitful. Each of these studies introduces separate ideas that are heuristically valuable. Each study forces a more rigorous statement of the variables.

Since Bayesian statistics is primarily based on the establishment of quantitative values for subjective values, we need to seek structure from the behavioral sciences. In classifying risk associated with buyer behavior, such as the risk averter, we need to study the decision-making process involved with each buyer. Such a study would involve the question, "How does a buyer decide to purchase a March futures contract in January rather than a July futures contract?"

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[9] Ibid., p. 64.

A paper by Kotler is framed in reference to buyers of grocery staples and their probability (P) of buying a particular brand A, B, or C. The brand loyalty is established by the brand purchase histories of consumers.[10]

Ronald E. Frank studied the effect of brand switching in regard to response uncertainty assuming that the consumer's behavior was based on constant brand probabilities. The difficulty with this constant probability is the denial of a correlation between marketing stimuli and consumer response. The thesis of this paper involves a correlation between variables and the decision-maker's weighting of these variables in assuming risk.[11]

In a stimulus-response (S-R) situation those stimuli that evoke a positive response reinforce that behavior. Dissatisfaction is a negative reinforcer and tends to reduce the likelihood of the operant eliciting the response which yielded dissatisfaction. This learning theory is applied by Kuehn which alters the current brand selection probabilities based on the previous brand choice. The degree of reinforcement of a particular behavior pattern is based on the n times a specified brand was selected in sequence. This study is especially important in the application of the individual-consumer buying probability to that probability for the market.

Individual investors, as they shift funds among futures contracts, determine the demand/supply relationship and the variance of the return for a particular risk class of commodity futures. Such a shift might be

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[10]Philip Kotler, "Mathematical Models of Individual Buyer Behavior," Behavioral Science, Vol. XIII, 1968.

[11]Ronald E. Frank, "Brand Choice as a Probability Process," Journal of Business, January 1962, Vol. XXXV, Number 1, pp. 43-56.

contrary to expectations based on the historical demand/supply relationship for a particular futures contract.

Kuehn's Markov model explains aggregate switching and staying power using r_j to represent the unadjusted probability that the consumer will select brand j again.[12] A_j represents the relative attractiveness of another brand. A_j in the commodity futures contract could represent the variables affecting demand. Kuehn measures A_j by an averaging of several variables affecting brand competition. The editorial comment on Kuehn is especially helpful in generalizing Kuehn's advertising example. His article discussing the effect of the time lag is also appropriate in regard to the effect of the introduction of fundamental information and its valuation in the commodity futures market. The variables in his model include competitive firms profit margins, brand loyalties of consumers, and industry advertising expenditures. Kotler extended the Kuehn model to encompass more dimensions of brand competition and made more explicit the effect of each marketing variable on the consumer. The effect of these changing marketing variables (i.e., prices, packaging, display, etc.) is presented in matrix form to the buyer. But the individual buyer places different weights on each of these variables. Some consumers are more affected by price change than the package change.[13]

Kotler's model assumes that an individual buyer's marketing response vectors do not change. A model without changing response vectors

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[12] A. A. Kuehn, "A Model for Budgeting Advertising," in F. M. Bass, et al., editors, Mathematical Models and Methods in Marketing, Richard D. Irwin, Homewood, Illinois, 1961, pp. 302-356.

[13] Kotler, loc. cit.

would not be sufficient for the commodity futures market. The commodity futures model is based on investor response to expected changes in commodity fundamentals (i.e., changes in the number of bushels of wheat produced; or, a drop in demand by bakers).

Kotler simulates the brand purchase probability vector ($BPPV_{it}$) for each buyer in a particular time period t by multiplying the buyers i and the marketing mix matrix. The particular brand that the buyer selects during the next time period would be based on the $BPPV_{it}$ using a Monte Carlo system to generate the choice.

Amstutz's model has both the changing consumer weights and the changing marketing mix. He has developed numerous models based on time series of brand shares where the events were determined through Monte Carlo selection. He has then compared them to historical time series in order to validate the model.[14]

Porat and Haas experimented with " . . . the effects of initial information and feedback on goal-setting and performance of the competing individuals."[15] The experiment was designed to discriminate on the value of more specific information given to one group than to another using an analysis of variance test. A correlation analysis was also run between goal-setting and goal achievement. This is similar to Cyert and March's goal setting hypotheses.

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[14] A. E. Amstutz, Computer Simulation of Competitive Market Response, The M. I. T. Press, Cambridge, Massachusetts, 1967.

[15] Avner M. Porat and John A. Haas, "Information Effects on Decision-Making," Behavioral Science, Vol. XIV, Number 2, March 1969, p. 98.

Probability Theory

Decision-Making. Decision-making, from a probability standpoint, had its origin in Bayes Theorem over two hundred years ago. It has only been in the last ten years that this method of decision-making has been utilized to any extent.

One of the first texts to generalize and apply Bayes Theorem for business decisions was by Robert Schlaifer. He exhaustively explains a method for decision-making that can be applied to most problems. Initially, a subjective probability distribution is constructed of the basic random variable. Bayes theorem is then used as an aid in assessing the distribution of a random variable from a sample. This additional information is then used in conjunction with a prior knowledge of the random variable to form a posterior distribution. This latter distribution is used as a basis for decision making regarding the value of the random variable.[16]

Game Theory. Through game theory the approach to decision-making has changed. Increasingly, decisions are based on a probability distribution rather than on a point estimate. Normally, the detail and accuracy of a continuous distribution is sacrificed for the relative ease of a discrete distribution. The sacrifice in accuracy should not be sufficient to render our results any less meaningful.

The game theory matrix has strategies established by both players. The states of nature strategies could be identified as those

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[16]Robert Schlaifer, Probability and Statistics for Business Decisions, McGraw-Hill Book Company, Inc., New York, 1959.

variables relevant to the decision at hand which cannot be affected by the decision maker. Thus, the value of the game to each player is based on the selection of a particular strategy by the other player. The strategies of one player are the state variables for the other player.

<u>The Markov Process</u>. The Markov process is characterized by a physical system. This system has a number of states of nature which do not remain constant over time. Each change in the state of nature is associated with a probability measure. The basis for these probability values is empirical data. The Markov process can assume either a stationary or non-stationary (time-dependent) model. The former assumes that the probability of switching from one state of nature to another remains constant. In the time-dependent model, the investors subjective appraisal of the states of nature changes over time. This changing value system leads to an increasing complexity of the model.

If a static model is employed, an equilibrium state is assumed. The influence of weather would have an equilibrium value of a specified probability just as government controls would have a specified probability of its effect on commodity price changes. At any one point in time, the states of nature might not have these equilibrium probabilities. Over a number of time periods (the length of time until the futures contract must be closed out) the probabilities of these short time periods will converge with the equilibrium state. The gain or loss from any period, though, is based on how quickly the current probabilities will converge (diverge) with (from) the equilibrium probabilities.

Assessing the Probability Distribution. The form of the distribution must be investigated to determine whether it is a normal, binomial, Poisson, etc., distribution. Many studies have been run on various security and commodity prices in order to obtain this information.

A study by Evans and Archer explored the distribution for common stock portfolios.

> The statistics employed in the calculation of ex post returns and the dispersion of these returns are the geometric mean and the standard deviation of the logarithms of the value relatives. The selection of these measures was a function of the following considerations. First, the geometric mean return is the yield with continuous compounding from holding a security (or portfolio for a given period). Second, examination of the data indicated that the distribution of the logarithms of the changes in stock prices was more closely "normal" than was the distribution of the arithmetic changes . . . [17]

A very prominent and early study of the wheat market was performed by Kendall in the 1940's. His study resulted in the finding that price changes in wheat followed a normal distribution.

A General Approach. Masse's text explains that an optimal investment strategy rests on several assumptions:

(1) that the states of the world that might occur can be enumerated and defined prior to the decision.

(2) that the investor can use current information available in order to assign probabilities to each state.

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[17] John L. Evans and Stephen H. Archer, "Diversification and the Reduction of Dispersion: An Empirical Analysis," Journal of Finance, December, 1968, Vol. XXIII, p. 763.

(3) the optimum selection of a decision rests on maximizing the expected value.[18]

Summary

In recent years continual progress has been made in the construction of models and the development of probability theory for decision-making. The literature related to decision-making from a commodity speculation standpoint has been drawn from investment theory, probability theory, and psychology.

Articles by W. F. Sharpe and E. F. Brigham explore empirical data from the common stock market and the convertible bond market. These studies are similar to the commodity study, but are discussed in general, elementary terms due perhaps to the exploratory nature of these studies. Of main interest in Sharpe's article is the application of the standard deviation and the earnings of firms to demonstrate a correlation from a risk-return point of view. Brigham uses the convertible bond market to show how selected decision variables interacted with the state variables. He constructs, using past data, the investors *ex ante* yield on convertible bonds.

The behavioral aspect of investment decision-making becomes more important as the determination of the state variables exhibit greater latitude. Within this context, the functional area of marketing is contributing greatly to our understanding of subjective variables. The problem of forecasting the individual consumers decision as well as the difficulty in forecasting group behavior, acts

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[18]Pierre Masse, *Optimal Investment Decisions: Rules for Action and Criteria for Choice*, Prentice-Hall, Englewood Cliffs, N. J., 1962.

as a strong stimulus for research. One important research paper in this area is by Philip Kotler. Kotler simulates the probability of a particular brand purchase in a specified time period using a Monte Carlo System.

From a probability standpoint, we find the Markov process best adaptable to the process under consideration for this paper. This game theory approach can be applied where the states of nature do not have equilibrium probabilities.

CHAPTER III

RANDOM WALK

Introduction

The theorists who advance the idea of the random walk hold that the security exchange is an efficient market in the economic sense and that it considers all factors that affect a stock. The information fed into a system is available to all, and a system of perfect competition exists. "In an efficient market at any point in time, the actual price of a security will be a good estimate of its intrinsic value."[1] Because this world is uncertain, there will always be some discrepancy in judgement of a security's intrinsic value. " . . . the actions of the many competing participants should cause the actual price of a security to wander randomly about its intrinsic value."[2] If the path were systematic rather than random, its future value could be predicted. If traders took advantage of this systematic movement, this would neutralize the gain.

The heart of the random walk theory is given in its definition. "A market where successive price changes in individual securities are independent is, by definition, a random walk market."[3]

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[1]Eugene F. Fama, "Random Walks in Stock Market Prices," Financial Analyst's Journal, September-October, 1965, p. 56.

[2]*Loc. cit.*

[3]*Loc. cit.*

If successive price changes are independent, then a history of stock prices would be valueless in predicting future stock prices.

The Effect of Information on Price Changes

Security prices vary with expected earnings. Without a change or expected change in earnings, there would be no change in the price of security x, ceteris paribus. Information about changes in earnings will bring about changes in security prices or a reevaluation of past data will bring an adjustment.

> Since there is no reason to expect that [sic] information to be non-random in its appearance, the period-to-period price changes of a stock should be random movements, statistically independent of one another. The level of stock prices will, under these conditions, describe what statisticians call a random walk and physicists call Brownian motion.[4]

Information usually reaches the market in different stages. There is an initial adjustment and then a series of successive adjustments in price as implications of the news is filtered.

Brownian Motion in the Stock Market

Louis Bachelier in 1900 constructed a random-walk model for security and commodity markets. His model is what is referred to as "Brownian motion." Brownian motion is adopted from a term used in physics to describe the velocity of particles in physical motion.

> . . . let Z (t) be the price of a stock, or of a unit of a commodity, at the end of time period t. Then it is assumed that successive differences of the form $Z(t + T) - Z(t)$ are independent, Gaussian or normally distributed, random variables with zero mean and variance proportional to the differencing interval T.[5]

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[4]Paul Cootner, "Stock Prices: Random vs. Systematic Changes," Industrial Management Review, Vol. III (1962), p. 25.

[5]Mandelbrot, Benoit, "The Variation of Certain Speculative Prices," Journal of Business, Vol. XXXVI (October, 1963), p. 394.

In his explanation of randomness in an economic time series,

> Bachelier proceeds . . . directly from the assumption that the expected gain (in francs) at any instant on the Bourse is zero, to a normal distribution of price changes, with dispersion increasing as the square root of time, in accordance with the Fourier equation of heat diffusion.[6]

The assumption that the variance of the difference $Z(t + T) - Z(t)$ is independent of the level of $Z(t)$ is probably erroneous. The error involves the likelihood that the standard deviation of $Z(t)$ is proportional to the price level. Thus, many authors have substituted for the original assumption of independent increments of $Z(t)$ be replaced by the assumption of independent and Gaussian increments of $\log_e Z(t)$. (Gaussian, Laplace and Normal curves are the same shape.)

> The expected value of an index is a function of the geometric mean and the variance of the distribution of price logarithms, hence of time, while the variance does not affect the geometric mean (which, . . . gives a more faithful representation than the expected value does of the phenomena described by the lognormal distribution.[7]

We have been introduced to the use of log paper by the technicians in their plotting of prices in order to preserve some perspective. Bernoulli suggested that the relation between a quantity and its utility was probably logarithmic rather than linear.

The Gaussian hypothesis holds,

> If the price changes from transaction to transaction are independent, identically distributed, random variables with finite variance, and if transactions are fairly uniformly spaced through time, the central limit theorem leads us to believe

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[6]M. F. M. Osborne, "Reply to 'Comments on Brownian Motion in the Stock Market'," Operations Research, Vol. VII (Nov.-Dec., 1959), p. 808.

[7]A. G. Lauraent, "Comments on 'Brownian Motion in the Stock Market'," Operations Research, Vol. VII (Nov.-Dec., 1959), p. 807.

> that price changes across differencing intervals such as a day, a week, or a month will be normally distributed since they are simple sums of the changes from transactions to transactions.[8]

This Gaussian hypothesis is supported by empirical evidence of Moore by his results on weekly changes in log prices of a sample of stocks from the New York Stock Exchange.

It is interesting to note the distribution of weekly changes in the logarithms of stock prices. "The mean of such weekly changes is very likely to be less than 0.005; the standard deviation, on the other hand, is likely to be much larger, usually between 0.02 and 0.03."[9]

This standard deviation is what makes the work of the professional trader profitable. The variance of stocks on a weekly basis allows profits to be taken on the highs and low prices during the day and the week.

As the time period under study increases in length beyond weekly changes, the mean becomes more important. It varies in direct proportion to the change in the interval (this is the difference between the high and low selling price) while the standard deviation varies only as the square root of the increase in the interval. It is obvious that the longer the period the greater will be the interval, it cannot become smaller. As time increases prices occur farther and farther from the mean.

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[8]Eugene Fama, "Mandelbrot and the Stable Paretian Hypothesis," Journal of Business, October, 1963, p. 420.

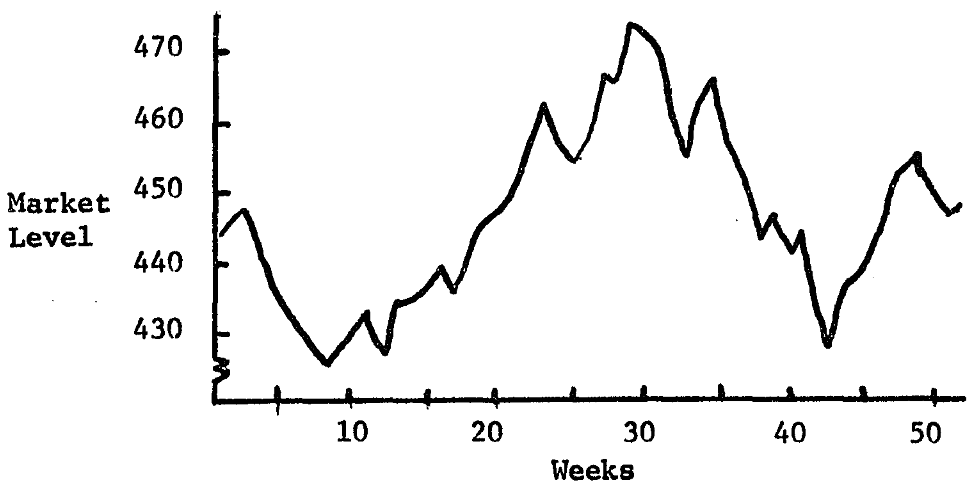
[9]Paul H. Cootner, "Stock Prices: Random vs. Systematic Changes," Industrial Management Review, Vol. III (1962), p. 27.

The Stable Paretian Hypothesis

Mandelbrot in adopting Pareto's laws for stock analysis has brought forward the stable Paretian approach to stock price changes. Kendall and Moore did several studies based on the stock market and on commodity changes. In Kendall's model on commodity markets he found that commodity prices behaved as if generated by a roulette wheel specifically designed for commodities. Thus the wheel had no memory, but certain sections of the wheel were more likely to come up than others. Thus a speculator would invest in these probabilities and pay no attention to recent spins, except as those spins added to the information for prediction.

FIGURE 1

SIMULATED MARKET LEVELS FOR 52 WEEKS



Source: Harry V. Roberts, "Stock Market 'Patterns' and Financial Analysis: Methodological Suggestions," Journal of Finance, Vol. XIV (1959), p. 5.

Figure 1 is a simulation of weekly changes in the Dow Jones Index using a mean of +0.5 and a standard deviation of 5.0.

The formation is remarkably like a "head and shoulders top." If a wheel could be constructed such that different patterns persisted and these patterns could be used to increase the gain on investing this would partially verify the system used by the technicians. When the system became widespread, then the gains would no longer exist. The system would correct for the imbalance.

Roberts suggests that chance in the market is not recognized for two reasons: (1) "The usual method of graphing stock prices gives a picture of successive levels rather than of changes, and levels can give an artificial appearance of 'pattern' or 'trend.' (2) A second is that chance behavior itself produces 'patterns' that invite spurious interpretations."[10] Thus, the different patterns interpreted by the technicians many times lead to false assumptions. Investments are made that are not successful. We often hear of a person's success in the market, but people are lax in admitting their errors in investing. Such errors show their judgement was poor whereas people are more prone to show when their judgement was verified.

Mandelbrot, in reflecting on the Kendall studies, shows these distributions are dissimilar to that of the normal distributions. The tails are higher and the peaks are flatter than in the normal curve. His stable Paretian approach makes two assertions: "(1) the variance of the empirical distributions behave as if they were infinite, and (2) the empirical distribution conforms best to the non-Gaussian members

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[10]Harry V. Roberts, "Stock Market 'Patterns' and Financial Analysis: Methodological Suggestions," Journal of Finance, Vol XIV (1959), p. 2.

of a family of limiting distributions which Mandelbrot has called stable Paretian."[11]

This assertion if true, will negate much of the findings of other authors.

> If the population variance of the distribution of first differences is infinite, the sample variance is probably a meaningless measure of dispersion. Moreover, if the variance is infinite, other statistical tools (e.g., least squares regression) which are based on the assumption of finite variance will, at best, be considerably weakened and may, in fact, give very misleading answers.[12]

Mandelbrot developed a distribution that could follow the above description and calls it "Martingale" property. The Martingale model assumes that it is possible that price changes are dependent, but this dependence is not of a form which can be used to predict future price changes. The future stock values, then, are independent of the past stock values, but the future distributions of stock prices could be dependent on past prices.

Let t = present instant of time, t + T = future instant of time, T = time increment, Z(t) = present price, t_i^o = arbitrary set of past instants, and Z(t+T) = future price.

These figures combine into the Bachelier equation of Z(t+T) - Z(t) = the successive differences between prices. Since we have previously shown that this distribution does not fit the normal curve we must adjust the model.

> If one divides by $T^{-\frac{1}{2}}$ the increment of a Gaussian process over a time increment T, one obtains the expression $T^{-\frac{1}{2}}[Z(t+T) - Z(t)]$ that has a distribution independent of T. The generalization of

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[11]Eugene Fama, "Mandelbrot and the Stable Paretian Hypothesis," Journal of Business, October, 1963, p. 421.

[12]*Loc. cit.*

> this property was discovered by Paul Levy, who showed that, if $0 < a < 2$ and the homogeneity exponent $\frac{1}{2}$ is replaced by a larger exponent $1/a$, one obtains a family of probability laws now called "stable Paretian."[13]

This exponent allows the marginal distribution of price change to be Paretian, but the increments do not have to be independent as in the random walk model.

Placing the model above in the context of the market we find that economic conditions supplying information (our random variable) are subject to abrupt changes (they are asymptotically Paretian). Variables that form an asymptotically Paretian curve have a larger risk than variables which form a Gaussian (normal) curve. Stop-loss orders will not protect the investor from large losses because in the stable Paretian

> . . . with $a < 2$; a large price change across a long interval will more than likely be the result of a few very large changes that took place during smaller subintervals. This means that if the price level is going to fall very much, the total decline will probably be accomplished very rapidly, so that it may be impossible to carry out many 'stop-loss' orders at intermediate prices.[14]

Since a is a measure of the height of the extreme tail areas of the distribution the probability of large price changes increases as a approaches 0. A given price level will then be attained by fewer price changes of a security if $a < 2$ than if the distribution of security price changes is Gaussian ($a = 2$).

It is assumed in the Martingale model that an exogenous trigger Y(t), i.e., news that brings about a price change, will quickly reach

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[13]Benoit Mandelbrot, "Forecasts of Future Prices, Unbiased Markets, and 'Martingale' Models," Journal of Business, Vol. XXXIX (January, 1966), No. 1, Part II, p. 243.

[14]Fama, op. cit., p. 427.

a limit. The present price of the stock will reflect the changes in earnings based on this new information. If this limit is reflected by Z(t) then: "(1) price and value will occasionally coincide; (2) price will be generated by a Martingale stochastic model in which the present Z(t) is an unbiased estimator of Z(t+T); moreover, for large values of T, Z(t) is an unbiased estimator of Y(t+T)."[15]

If the exogenous trigger had properties other than having the present price reach a limit, then the forecasted future value based on this present value need not be a Martingale.

> . . . the fact that forecasting of the value leads to a Martingale in the prices tells us something about the structure of the value as well as the structure of the market mechanisms. If forecasted value does not follow a Martingale, prices could follow a Martingale only if they do not follow value.[16]

The above statement is especially important to this treatise. The treatise presumes that a forecasting approach can be developed which will outperform a random selection of commodities of similar risk.

Filters

In our studies we have been introduced to formula-timing plans. The filter technique is such a plan. The filter technique is applied as follows: "Choose a percentage x, say 5%. If the average rises by 5%, buy, and if it declines by 5%, sell."[17] Alexander attempts through the use of filter techniques to demonstrate that these techniques would yield better results than the random walk hypothesis. His findings do

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[15]Mandelbrot, op. cit., p. 244.

[16]Loc. cit.

[17]Sidney S. Alexander, "Price Movements in Speculative Markets: #2," Industrial Management Review, Spring, 1964, p. 25.

contradict that of the random walk, but they have many shortcomings that make his conclusions invalid. The data is based on the prices of the industrial averages on the New York Stock Exchange, the Dow-Jones Industrials from 1897 to 1929, and Standard and Poor's Industrials from 1929 to 1959.

Alexander assumes, contrary to Dow theory, that the price of a stock is not immediately adjusted with the introduction of new information. He assumes that there exist trends in the reading and interpreting of news. "The future trend of price will result from a gradual spread of awareness of these facts throughout the market."[18] If the price moved up x percent it should "move up more than x percent further before it moves down by x percent."[19]

A serious shortcoming in Alexander's technique is the assumption that the trader could always buy at a price exactly x percent above, but because of price jumps this is rarely true. The sell or buy price would not always be triggered at the exact price of the filter movement.

After correction for most bias, a new set of data was computed, and from the results,

> it is evident that when brokerage fees are included none of the filters consistently produced large returns. All filters below 12 percent and above 25 percent produce negative average returns per security after commissions. Although filters between 12 percent and 25 percent yield positive returns, they are small when compared to .0986, the average return for all securities from a buy-and hold policy. These results support the conclusion

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[18] *Loc. cit.*, p. 26.

[19] *Loc. cit.*

> that the filter techniques cannot be used to increase the expected profits of the investor who must pay the usual brokerage commissions.[20]

Of significance in this filter technique is the dependence of prices in the small filter sizes before commissions. The first three filter sizes of 0.5, 1.0, and 1.5 percent in the table below show greater average returns on long positions (column 3) than the average return from buy-and-hold, .0986.

> The returns on both long and short positions, however, fall dramatically as the filter size is increased. This behavior of the returns on the smallest filters is evidence of persistence or positive dependence in very small movements of stock prices. The results indicate that the conditional probability of a positive (negative) change tomorrow, given a positive (negative) change today, is greater than the unconditional probability, but the effect of today's change on subsequent changes decreases very rapidly as one predicts further into the future.[21]

The findings then for these stock price filters would seem to give some verification for the Martingale theory.

The difficulties of making a profit under actual conditions will still make the buy-and-hold superior even if brokerage fees are not paid. Such items are: the clearinghouse fee, the possibility that funds might lie idle while waiting for a filter to trigger, and the costs of search and keeping up with the transactions.

Does the Random Walk Have a Time Horizon?

The commodity market has been the subject of a great quantity of research in the random walk area. Many of these studies have come

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[20] E. F. Fama and M. E. Blume, "Filter Rules and Stock-Market Trading," Journal of Business, Vol. XXXIX (January 1966), No. 1, Part II, p. 237.

[21] *Loc. cit.*, pp. 237-238.

TABLE 1

NOMINAL ANNUAL RATES OF RETURN BY FILTER: AVERAGED OVER ALL COMPANIES

FILTER	AVERAGE RETURN PER SECURITY		BREAKDOWN OF AVERAGE RETURN PER SECURITY BEFORE COMMISSIONS		NO. OF PROFITABLE SECURITIES PER FILTER	TOTAL TRANSACTIONS
	Before Commissions (1)	After Commissions (2)	Long (3)	Short (4)	(5)	(6)
0.005..........	.1152	-1.0359	.2089	.0097	27/30	12,514
.010..........	.0547	- .7494	.1444	-.0518	20/30	8,660
.015..........	.0277	- .5614	.1143	-.0813	17/30	6,270
.020..........	.0023	- .4515	.0872	-.1131	16/30	4,784
.025..........	-.0156	- .3732	.0702	-.1378	13/30	3,750
.030..........	-.0169	- .3049	.0683	-.1413	14/30	2,994
.035..........	-.0081	- .2438	.0734	-.1317	13/30	2,438
.040..........	.0008	- .1950	.0779	-.1330	14/30	2,013
.045..........	-.0117	- .1813	.0635	-.1484	14/30	1,720
.050..........	-.0188	- .1662	.0567	-.1600	13/30	1,484
.060..........	.0128	- .0939	.0800	-.1189	18/30	1,071
.070..........	.0083	- .0744	.0706	-.1338	16/30	828
.080..........	.0167	- .0495	.0758	-.1267	15/30	653
.090..........	.0193	- .0358	.0765	-.1155	17/30	539
.100..........	.0298	- .0143	.0818	-.1002	19/30	435
.120..........	.0528	.0231	.0958	-.0881	21/30	289
0.140..........	.0391	.0142	.0853	-.1108	19/30	224

TABLE 1 (Cont.)

NOMINAL ANNUAL RATES OF RETURN BY FILTER: AVERAGED OVER ALL COMPANIES

FILTER	AVERAGE RETURN PER SECURITY		BREAKDOWN OF AVERAGE RETURN PER SECURITY BEFORE COMMISSIONS		NO. OF PROFITABLE SECURITIES PER FILTER	TOTAL TRANSACTIONS
	Before Commissions (1)	After Commissions (2)	Long (3)	Short (4)	(5)	(6)
0.160..........	.0421	.0230	.0835	-.1709	17/30	172
.180..........	.0360	.0196	.0725	-.1620	17/30	139
.200..........	.0428	.0298	.0718	-.1583	20/30	110
.250..........	.0269	.0171	.0609	-.1955	15/29	73
.300..........	-.0054	-.0142	.0182	-.2264	12/26	51
.400..........	-.0273	-.0347	-.0095	-.0965	7/16	21
0.500..........	-.2142	-.2295	-.0466	-.1676	0/4	4

Source: E. F. Fama and M. E. Blume, "Filter Rules and Stock-Market Trading," Journal of Business, Vol. XXXIX (January, 1966), Number 1, Part II, p.237.

to the conclusion that the commodity market does in actual fact follow a random walk. The random walk is of extreme importance to any trader, as such a finding would exclude the possibility of a pure profit (a profit beyond that of the random walk) through a biased approach. From the standpoint of the securities market, R. A. Levy has selected a number of time periods of varying lengths in order to determine a point at which the random walk ceases to be valid. For his study he selected a sample of 200 stocks from the New York Stock Exchange encompassing data from the 1960-1965 time period. He compared selected technical trading rules with a random selection of securities using a buy and hold strategy. The technical trading rules were superior to the buy-hold strategy with a 26 week time interval or greater, which suggests in a limited way that the random walk is valid for differencing periods of less than 26 weeks.

Levy's data was drawn from the New York Stock Exchange whose market cannot be considered identical to that of the Chicago Board of Trade. Since both are auction markets based on changing supply and demand, many strong similarities do exist. It does suggest that in auction markets trading rules can be established that will consistently outperform a random buy-hold strategy.[22]

Summary

The studies analysed in this section of the paper are remarkable for their conflicting conclusions. Several approaches to the random walk have been explained. Examples such as the Martingale, a strict

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[22] R. A. Levy, "The Theory of Random Walks: A Survey of Findings," The American Economist, Fall 1967, Vol. XI, No. 2, pp. 34-48.

random walk, and filter techniques have been described. Authors using the same approach have come to different conclusions. Each author makes different assumptions as to the weight that should be placed on certain sectors of the problem. One author might assume perfect competition whereas another might assume a biased market. This latter has been held in regard to a number of stocks on the American exchange. It is the assumptions that bring about the conflicting conclusions.

The major area of disagreement is the assumption of a normal distribution, as probability estimates have been based on a normal distribution. The most recent findings suggest, however, that stock market prices do not follow a normal distribution. Rather, they follow a stable Paretian distribution.

It takes time for information to be considered fully by the investor and reflected in the stock price. Adjustments in security prices wander randomly about the intrinsic value and the spread narrows over time. Where expectations cannot be estimated with any precision these stocks have the greatest range and the greatest mean change. These stocks then have a greater inherent risk than those stocks whose earnings can be more accurately forecast. This, of course, is the rational between the risk-return hypothesis.

Several studies involving large auction markets have demonstrated that the random walk is valid only over a specified time period. This is not to say that the random walk is valid, but only that trading rules have not been formulated which can outperform a random selection employing a buy-hold strategy over all time periods.

CHAPTER IV

THE COMMODITY MARKET

Introduction

The investment environment under analysis is the wheat area of the commodity market. This chapter describes the major factors applicable to commodity investments in general and wheat in particular.

The function of the exchange is presented first along with a description of typical transactions that take place. A section is included which contrasts the distinctions between commodity trading and stock trading. The mechanical aspects of trading in commodities is then explained along with some of the approaches used. Though one cannot have verifiable information on the commodity traders employing certain techniques, it is generally held that about 80 percent or more of the speculators use charting as a major factor in their investment decisions.[1] It is also assumed that almost every investor uses fundamental information in his decisions. As the downside risk is established partially by parity prices, such prices along with the International Wheat Agreement are treated.

The Exchange

Commodities are traded on several exchanges, the principal of which is the Chicago Board of Trade. Not only is it the largest

[1]Based on discussions with the account executives of several major brokerage houses.

commodity trading area in the world, it also has the greatest volume of wheat transactions. All contracts traded on the Chicago exchange are specified as to the quality of the commodity. In reference to wheat, it is specified as ordinary soft red winter wheat and the seller has the option of delivering a grade other than the one specified. An adjustment in price is made for the difference in quality.

The function of the commodity exchange is to provide an organized market place for its members. The members act in their own interest, and also for others in a broker capacity. The transactions that occur are executed by speculators or hedgers. The exchange helps the seller (buyer) of the raw material to confine himself to his primary business rather than assume the risk of speculating on the future price of a commodity. A flour miller can then enter a contract to deliver flour in the future without assuming a tremendous inventory risk. The flour miller hedges his future delivery by buying a wheat futures contract. Unpredictable price changes are then shifted to speculators from those who deal in cash commodities. The speculator can take a long or short position depending upon his expectation of price movement. If he believes supply will exceed demand, then he will assume a short position. A short position is the sale of a specified commodity for later delivery. A long position is the purchase of a contract which was sold short. Another major type of transaction is the straddle. The speculator takes a position in one delivery month and assumes the opposite position in a different delivery month or even in a different grain such as oats.

Trading in Commodities

Trading Distinctions between Common Stocks and Commodities. Both common stocks and commodities are traded on major exchanges. Both are considered for investment and speculative purposes. In many ways, the factors important to each are similar. These factors include the monetary situation, war, and the political situation. In many ways, the two markets are distinct. Listed below are 10 basic distinctions.

1. When it comes to the long term price changes in the commodity markets, there is no such thing as 'inside information' which would give a theoretical 'insider' in the commodity business any advantage over the speculator. The important statistics are 'public' and new developments become available to all concerned at about the same time.[2]

2. Margin requirements for commodities are normally 5 - 10 percent depending on the commodity.

3. A stock can be held for a long-term investment for periods in excess of one year. "The commodities: wheat, oats, rye, corn, soybeans, and many others are traded up to one year."[3]

4. The amount of shares issued and outstanding of a corporation is a known factor. The amount of commodity futures is unknown.

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[2]Milton Jiler, "Understanding the Commodity Futures Markets," in Guide to Commodity Price Forecasting, Harry Jiler, editor, Commodity Research Bureau, Inc., 82 Beaver St., New York, 1965, p. 6.

[3]Gerald Gold, Modern Commodity Futures Trading, Commodity Research Bureau, Inc., 82 Beaver St., New York, 1959, p. 15.

5. Since the commodity market is a futures market, the long and short sales of the commodity are exactly equal. In common stocks, short sales do not have to be equal to the outstanding shares.

6. The U.S. Government has placed a floor under certain commodities with the price support program.

7. The commission for commodity trades is paid when the futures transaction is closed. In stocks, the commission is paid at the time of purchase and at time of sale, since there is the possibility that the purchaser might never sell.

8. Selling stocks short requires the price of that stock to be going up. A rising price is not required for commodities.

9. Commodity futures trading involves no immediate transfer of a commodity. It is a claim against the future delivery of the commodity.

10. In common stocks, an investor may purchase a multiple of shares, whereas in commodities one is limited to job lots or round lots. The size of a lot differs for each commodity.

Mechanical Aspects. In regard to the mechanical aspects of trading in commodities, grains are normally traded in eighths of a cent. For grains a trade consists of a 5,000 bushel contract, and thus a one cent change in the price of a bushel has a $50 value. Each eighth of a point is worth $6.25. The standard round lot is 5,000 bushels. A job lot is 2,000 bushels, but these sales have almost been eliminated. Should the daily fluctuation of a grain reach ten points above or below the previous day's closing, trading in that commodity is suspended.

Grain futures can be traded in at any time, but certain months have become standard. These trading months are December, March, May, July, and September. Thus in early June a speculator might buy a December wheat future. Using only five months promotes greater volume and a more determined price.

Theoretically future months should sell only at a carrying charge over any prior month. If the differential between a future price and a prior month is greater than the carrying charge, a premium is involved, if less, a discount. This premium, though, applies only to the less perishable commodities as other commodities might not retain their quality between periods. For perishables, an additional risk premium would be required.

Two terms used frequently in regard to the amount of trading activity are volume and open interest. "The term volume represents a simple addition of successive futures transactions. It is a barometer of trading activity and a measure of the intensity of supply and demand for certain periods of time."[4]

> Open Interest to open contracts are purchase or sale commitments which traders have entered into and which remain outstanding. When speaking about open interest, one refers to the number of unliquidated contracts and never to the point total of sales and purchases . . . . Open interest only increases when new purchases are offset by new sales. If a new purchase is offset by the sale of a previously purchased contract, then there would be no change in open interest. Decreases in open interest occur when previous purchases are sold and are offset by the buying in of previously sold contracts. This would mean that both buyers and sellers were closing out previous commitments.[5]

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[4]William L. Jiler, "Volume and Open Interest," in Harry Jiler, editor, *op. cit.*, p. 61.

[5]*Loc. cit.*

Rules Governing Commodity Trading. Commodity trading is regulated by the Securities and Exchange Commission and trading is enacted through commodity exchanges. Each exchange has a clearinghouse through which members clear their trades on a daily basis. Each member firm is required to have on deposit a margin sufficient to cover his debit balance. The clearinghouse is then responsible to all members for contract fulfillment. Thus Broker A who sells commodity X is not responsible to Broker B who purchased the contract. Broker B has a claim against the clearinghouse. Broker A is responsible to the clearinghouse.

The time of delivery of a futures contract is determined by the delivery month. If this month is December, then the seller has the option of delivering at any date during the month. The seller also has the option of delivering one of several grades. On the exchange, the quoted prices are for a basic contract grade. The seller can deliver a commercially acceptable grade different from this basic grade. If he does, a premium or discount is made on the contract in relation to the grade delivered.

In regard to definition, the difference between old and new crop futures exists in that old crop futures have to be delivered from the existing old crop supply. The new crop future will be delivered out of those supplies to be produced.

Crop years are used instead of calendar years for trading. The crop year begins with the first of that month in which the majority of the crop is harvested. This crop year is of the same length as the calendar year. For wheat the crop year begins July 1.

What is important between crop years and old and new crops is the prospects for the yields in both periods. Thus, if the old crop futures are scarce and new crop supplies have good prospects, then these new crop futures will sell for less than the old crop. If growth could be hastened through special techniques, it might be advantageous to get these new crops into the old crop year.

Approaches to Commodity Trading

Chart Formations. The basis for charting is a graphical representation of price changes. It is hypothesized that certain price patterns are repetitive. From these patterns, the future trend of prices can be anticipated. One of the most widely used charts in commodities is the vertical bar graph which portrays the daily high, low, and closing points of commodity price movement. In contrast to stock price charting, the volume for commodities is not always charted. Information is just not available to plot volume for each monthly contract. Volume is given in the form of a summation for all contracts of a given commodity. This volume is not available after each day's trade, but becomes available two days later. The technical analysts in commodity trading rely heavily on the recognition of patterns without the accompanying volume.

The patterns have their origin from work done in statistical quality control. The application of this system can be illustrated by a soft drink company. If the company fills the bottles too high, it will raise its costs. If the bottles are not filled high enough, the Food and Drug Administration will step in. A quality control system would then be instituted to determine the average fill and standard deviation. Should the charts kept on these samples pass a certain limit, the system is termed "out of control." In regard to chart formation for commodities, the system would be out of control when the graph passed a certain level as determined by past formations. Should the commodity break out on the downside it would be a bearish indication, if the line broke on the upside it would be bullish. Should this occur, it would symbolize that the system was "out of control" and would continue to move in the direction of the breakout until other factors changed its direction.

For commodities and stocks, it is assumed that various forces represent demand and supply. As the balance between these forces shifts, the pattern represented by the vertical chart changes. It is the interpretation of these chart patterns that leads to decision making on the part of chart analysts. The repetition of patterns is exemplified by the head and shoulders formations for wheat during the month of February for many past years.[6] As in stocks certain commodities seem to favor certain patterns. Saucer and rounded tops are predominant in cotton, but rare in other commodities.

If we do combine our volume and price information we can set up what constitutes a weak or strong market just as we do for stocks:

Price Up

Volume and Open Interest Up - Strong
Volume and Open Interest Down - Weak

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[6]William Jiler, "Forecasting Commodity Price with Vertical Line Charts," in Harry Jiler, editor, *op. cit.*, p. 26.

[7]*Ibid.*, p. 30.

Price Down

Volume and Open Interest Up - Weak
Volume and Open Interest Down - Strong

Fundamental Market Analysis. The basic factors affecting commodity prices are examined through fundamental analysis. The basis for price changes in wheat is the change in the balance between supply and demand.

The government supplies most of the pertinent statistics in regard to commodities which are referred to as official estimates. These estimates are released to the news media at specified times and thus there is really no insider information to these statistics. These estimates are computed on a crop year basis rather than a calendar year. The crop year for wheat begins July 1.[8]

The total supply of a commodity is the cumulative total of three factors: (1) the new crop, (2) the old crop carryover, and (3) expected imports. This old crop carryover is from all past seasons and comprises all stocks in storage.

Table 2 refers to these three groupings as carryover, production, and imports. The demand side is labelled disappearance. The U.S. Department of Agriculture makes estimates of this usage and supply from primary sources.

In addition to the demand and supply factors, the U.S. Government has a price support program. The government owns a substantial amount of wheat and has another substantial part under loan. This supply is pegged at a certain price by the government and will

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[8]William Jiler, op. cit., p. 63.

TABLE 2

Wheat: Supply, distribution and prices, average 1968-68 and annual 1966-69

Item	Average 1964-68	1966	1967	1968 1/	1969 Projected
	Year beginning July				
	- - - - Million bushels - - - -				
Supply					
Beginning carryover	643.6	535.2	425.0	539.4	819
Production	1,401.9	1,311.7	1,522.4	1,576.2	1,459
Imports 2/	1.2	1.7	.9	1.1	1
Total Supply	2,046.7	1,848.6	1,948.3	2,116.7	2,279
Domestic disappearance					
Food 3/	513.1	501.9	519.2	519.8	525
Seed	67.8	78.4	71.5	61.6	55
Industry	.1	.1	.1	.1	---
Feed (residual) 4/	110.2	98.9	57.0	172.5	200
On farms where grown	(40.1)	(26.1)	(42.9)	(58.6)	
Total	691.2	679.3	647.8	754.0	780
Available for Export and Carryover	1,355.5	1,169.3	1,300.5	1,362.7	1,499
Exports 2/	728.4	744.3	761.1	544.1	600
Commercial, incl. barter	(322.6)	(438.8	(366.9)	(293.2)	
Total disappearance	1,419.6	1,423.6	1,408.9	1,298.1	1,380
Ending carryover	627.1	425.0	539.4	818.6	899
Privately owned--"Free"	(194.5)	(223.7)	(216.2)	(202.9)	
	- - - - Dollars per bushel - - - -				
Price Support					
National average loan rate	1.26	1.25	1.25	1.25	1.25
Average certificate paym't	.50	.59	.48	.55	.65
Season Average Price Rec'd					
By non-participants	1.39	1.63	1.39	1.24	1.23
By program participants	1.89	2.22	1.87	1.79	1.88

1/ Preliminary

2/ Imports and exports are of wheat, including flour and other products in terms of wheat.

3/ Used for food in the United States and U.S. territories, and by the military both at home and abroad.

4/ Assumed to roughly approximate total amount used for feed, including amount used in mixed and processed feed.

Source: Wheat Situation, Economic Research Service, U.S. Department of Agriculture, February, 1970, Table I, p. 2.

not be sold until authorized by the Department of Agriculture. A "free supply and demand balance" must then be calculated in order to determine wheat's availability for private sale. It is something like the available floating common stock for a corporation. The free supply can best be calculated by adding: (1) free supply carryover; (2) new crops; (3) estimated imports, and (4) estimated total CCC sales.[9] From this total one must subtract the estimated disappearance. Since most investments will depend on the amount of free supply, it is necessary to judge the range in which prices will vacillate.

If there is a free supply scarcity, " . . . the lower limit of the range is the discount necessary to draw the surplus portion of the supply under loan and the top limit of the range is the premium over the loan necessary to start drawing loan stocks, or government owned stocks, back into free supply channels."[10] Thus, if prices are low, more and more farmers will put their stocks under loan, thus reducing the outstanding free supply. The government, conversely, will place its stocks on the market if the price goes too high, and the farmers that can do so will take their stocks out of loan to sell at the higher prices.

Prices and Parity

Parity. The federal government has established parity prices for commodities in order to relate farm prices to price changes in other sectors of the economy. Parity is the relationship of prices in

[9] Chester W. Keltner, How to Make Money in Commodities, The Keltner Statistical Service, 1004 Baltimore Ave., Kansas City, Mo., 1960, p. 122.

[10] Ibid., p. 126.

one time period to the prices of a base period. Parity prices are computed in the following way:

> 1) Divide the past ten years average farm price for a particular commodity by the average index of prices received for all farm products during these same ten years.
>
> 2) Multiply this by the index of costs covering goods and services farmers buy (1910 - 1914 base). The support price for a particular commodity is then set at a percentage of this parity price.[11]

These parity prices are published monthly by the Department of Agriculture. If marketing quotas are in effect, as they are at the present time, farmers can only use up to a certain given percentage of their allotment. If quotas are in effect for the 1971/72 marketing year, " . . . the level of total price support (loan rate plus certificate value for domestic food production) would be set between 65 and 90 percent of parity."[12] The value of these certificates is the difference between the price support level of $1.25 and the parity price of wheat at the beginning of the next marketing year.

Those participating in the wheat programs have several options:

> 1) They may substitute wheat for feed grains or feed grains for wheat if they take part in both the wheat and feed grain programs.
>
> 2) They may make advance arrangements to overplant allotments by up to 50 percent if the excess production will be stored for later sale under specified conditions or delivery to the Secretary.

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[11] Gold, _op_. _cit_., p. 87.

[12] _Wheat Situations_, Economic Research Service, U.S. Department of Agriculture, February, 1970, p. 8.

3) They may underplant allotments up to 55 percent without affecting eligibility for marketing certificates.
4) Winter wheat producers may plant designated non-surplus crops on acreages diverted beyond the minimum.[13]

The above legislation has continued to the present.[14]

International Agreements. The United States has entered an agreement with a number of nations on the exportation and importation of grains. The International Wheat Agreement has been succeeded by an agreement among the cereals group of the General Agreement on Tariffs and Trade. Not all members of GATT are members of the cereals group. This group includes the United States, Canada, Australia, United Kingdom, Japan, Denmark, Sweden, Norway, Switzerland, and the European Economic community.[15]

The actions by the United States, then, have an immediate effect on the other grain producing countries. The United States is the only major nation which supports a private grain trade.

Prices. The price supports will be effective as long as the government has sufficient supplies to place on the market to establish a ceiling and the authority to establish a floor. By referring to these price programs, an investor can reasonably establish a trading range for a given commodity. In regard to wheat, prices have been in a down trend since 1952 and this decline is tied almost directly to government programs, such as the Food and Agriculture Act of 1965. Within the price range established by the government

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[13] Wheat Situation, Economic Research Service, U.S. Department of Agriculture, February, 1966, p. 9.

[14] Wheat Situation, op. cit., February, 1970, p. 8.

[15] Wheat Situation, op. cit., May 1967, p. 11.

a price difference based on the geographic distance to the central market exists. Normally this differential is the transportation and trading costs involved. Should there be a wider discrepancy, arbitrage would narrow the gap.

Summary

The Chicago Board of Trade is the largest auction market in the world. Over two-thirds of United States wheat is traded at this auction point. Prices are determined by supply and demand and are not set by the Chicago Board of Trade. Trades are conducted in many commodities, but this paper is concerned with futures contracts of wheat. Trading takes place in five contracts, March, May, July, September, and December. More contracts with delivery specified on other dates could have been arranged, but using only five months provides greater activity for a contract, and hopefully, a more competitively determined price.

Many differences exist between the commodity and common stock markets. The main difference is that commodity markets deal in futures contracts. These are contracts for items which may not exist at the time the contract is entered into. Commodity trading is regulated by the Securities and Exchange Commission.

Prices for grains are determined by anticipated supply and demand. Supply is measured by carryover (held under loan by government, stored by government, etc.), production, and imports. Demand is noted as domestic disappearance and exports. Domestic disappearance consists of food, seed, industry, and feed.

The federal government has enacted numerous agriculture acts which support prices of commodities such as the Food and Agriculture Acts administered by the Department of Agriculture. The establishment of parity prices, acreage allotment, and loan conditions act as forces affecting price.

Charts are used by approximately 80 percent of commodity speculators. The charts are usually graphs of the daily or weekly high-low prices for each contract. These charts are similar to charts used in statistical quality control and provide information on the range and price variation.

The subsequent chapter searches the daily price data for meaningful patterns in order to develop a risk factor for commodity speculation.

CHAPTER V

THE SELECTION OF RISK CLASSES

Introduction

Examination of historical price data suggests that certain calendar months exhibit a greater price variance than other calendar months. Such price variance differences can be related to a specified calendar month (June, July, August, etc.) in which an option is purchased. The price variance differences can also be related to the period of time encompassed by the purchase date of the option and the required delivery date of the option.

Certain months, then, appear to have a greater risk than other months on an *ex post* basis. By knowing the risk on an *ex post* basis, the speculator may set his limit order with respect to the expected price variance of the particular calendar month and the particular option in which he is taking a position.

The Margin Requirement

In the grains, the margin requirement is exceptionally narrow compared to the margin required for listed securities. The margin requirement for commodities may vary between different brokerage houses. If a contract is purchased on margin, an investor will normally have some idea as to the loss he is willing to assume. The commodity trade responds to the amount of loss to be assumed by the adage, "Never answer a margin call." The truism is based on the expectation of price movements and the difficulty of reversing a trend. If the price has moved the distance necessary to require the brokerage house to ask for more security (margin call), the price is expected to keep moving in a negative direction. The initial margin required at the present time by a major brokerage house is $500 for a wheat contract. A margin call is normally forthcoming from the brokerage house when the equity in a commodity account falls to 25 per cent of the initial margin.

The Stop-Loss Point

Tables 3 and 4 aid the investor in assessing the risk he is assuming in a particular option contract. The tables present the mean, standard deviation, range, and t value at the .01 level multiplied by the standard deviation of the daily price differences (high price minus the low price for the day) for the years 1957-1961 and 1966-1968. These dates straddle the Agriculture Acts of 1964 and 1965 which contain important revisions in the price support and acreage allotment programs of the United States for certain commodities. The same computer program may be used with the data from both time periods to compare the consistency of output over time.

From the investor's standpoint, the degree of price fluctuation and direction determine whether he will be stopped out or not. An investor is stopped out when a stop-loss order is triggered. A stop-loss order automatically becomes a market order when the price of the commodity reaches the level stated in the stop-loss order. The order is then executed "at the market."

The amount of loss that can be absorbed by an investor would normally include the following factors. First, an investor might want to

TABLE 3

MEAN (X), STANDARD DEVIATION (S), STANDARD ERROR (SE), AND RANGE (R) OF THE DAILY PRICE VARIATION FOR THE FUTURES CONTRACTS MARCH, 1956 TO SEPTEMBER, 1962. DATA PRESENTED IN DOLLARS.

Futures Contract		Jan.	Feb.	Mar.			
3/56	X	.0136	.0154	.0241			
	S	.0061	.0083	.0184			
	SE	.0013	.0019	.0049			
	T*S	.0154	.0210	.0482			
	R	.0450	.1012	.1888			
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0131	.0177	.0193	.0154	.0148	.0126
	S	.0043	.0053	.0136	.0059	.0044	.0047
	SE	.0010	.0011	.0030	.0013	.0010	.0010
	T*S	.0109	.0133	.0342	.0148	.0111	.0118
	R	.0637	.0962	.1400	.0675	.0588	.0662
		Jan.	Feb.	Mar.	Apr.	May	June
3/57	X	.0128	.0193	.0204	.0248	.0197	.0199
	S	.0058	.0084	.0115	.0075	.0072	.0077
	SE	.0012	.0019	.0031	.0016	.0015	.0017
	T*S	.0146	.0214	.0302	.0190	.0181	.0193
	R	.0838	.0662	.1438	.1125	.1362	.1075
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0181	.0177	.0138	.0153	.0183	.0160
	S	.0093	.0064	.0055	.0057	.0058	.0095
	SE	.0020	.0013	.0013	.0012	.0013	.0021
	T*S	.0234	.0159	.0139	.0142	.0147	.0241
	R	.1450	.1038	.0650	.1225	.0712	.0675
		Jan.	Feb.	Mar.	Apr.	May	June
3/58	X	.0169	.0153	.0186	.0102	.0121	.0196
	S	.0053	.0042	.0109	.0036	.0059	.0090
	SE	.0011	.0009	.0029	.0014	.0013	.0020
	T*S	.0132	.0105	.0286	.0109	.0147	.0227
	R	.0750	.0750	.0788	.0250	.0675	.1488

TABLE 3 - Continued

Futures Contract		July	Aug.	Sept.	Oct.	Nov.	Dec.
3/58	X	.0187	.0157	.0135	.0148	.0110	.0135
	S	.0074	.0055	.0048	.0059	.0029	.0057
	SE	.0016	.0012	.0011	.0012	.0007	.0012
	T*S	.0185	.0137	.0122	.0148	.0074	.0144
	R	.0613	.0775	.0975	.0825	.0412	.0875
		Jan.	Feb.	Mar.	Apr.	May	June
3/59	X	.0099	.0100	.0192	.0114	.0114	.0137
	S	.0038	.0069	.0077	.0061	.0065	.0050
	SE	.0008	.0016	.0020	.0013	.0014	.0011
	T*S	.0095	.0175	.0201	.0154	.0163	.0127
	R	.0312	.0862	.0725	.0600	.0600	.0487
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0139	.0095	.0098	.0088	.0112	.0096
	S	.0074	.0046	.0047	.0040	.0045	.0038
	SE	.0016	.0010	.0010	.0008	.0011	.0008
	T*S	.0185	.0115	.0118	.0100	.0114	.0095
	R	.0963	.0500	.0500	.0538	.0312	.0600
		Jan.	Feb.	Mar.	Apr.	May	June
3/60	X	.0095	.0100	.0130	.0105	.0085	.0103
	S	.0033	.0043	.0066	.0050	.0043	.0051
	SE	.0007	.0010	.0016	.0011	.0009	.0011
	T*S	.0084	.0109	.0170	.0126	.0108	.0128
	R	.0475	.0437	.0938	.0525	.0400	.0588
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0079	.0074	.0083	.0084	.0098	.0088
	S	.0028	.0024	.0033	.0036	.0026	.0039
	SE	.0006	.0005	.0007	.0008	.0006	.0008
	T*S	.0071	.0060	.0082	.0091	.0066	.0098
	R	.0375	.0337	.0413	.0538	.0475	.0412

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.	Apr.	May	June
3/61	X	.0135	.0153	.0141	.0035	.0055	.0048
	S	.0054	.0047	.0085	.0029	.0030	.0016
	SE	.0012	.0011	.0022	.0007	.0007	.0003
	T*S	.0135	.0119	.0222	.0074	.0077	.0039
	R	.0763	.0737	.0725	.0175	.0188	.0250
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0069	.0055	.0057	.0065	.0111	.0097
	S	.0018	.0021	.0026	.0024	.0041	.0031
	SE	.0004	.0004	.0006	.0005	.0009	.0007
	T*S	.0045	.0051	.0066	.0060	.0103	.0078
	R	.0250	.0325	.0312	.0425	.0425	.0425
		Jan.	Feb.	Mar.	Apr.	May	June
3/62	X	.0101	.0085	.0113	.0084	.0076	.0109
	S	.0051	.0032	.0041	.0041	.0028	.0055
	SE	.0011	.0007	.0011	.0009	.0006	.0012
	T*S	.0129	.0082	.0108	.0103	.0071	.0138
	R	.0600	.0500	.0712	.0350	.0450	.0788
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0133	.0115	.0086	.0113	.0066	.0071
	S	.0038	.0036	.0030	.0047	.0019	.0034
	SE	.0008	.0007	.0007	.0010	.0004	.0008
	T*S	.0095	.0089	.0076	.0119	.0049	.0085
	R	.0587	.0438	.0400	.0425	.0275	.0387
		Jan.	Feb.	Mar.	Apr.	May	June
5/56	X	.0127	.0146	.0170	.0289	.0428	
	S	.0048	.0061	.0047	.0108	.0246	
	SE	.0010	.0014	.0010	.0024	.0063	
	T*S	.0121	.0155	.0119	.0272	.0639	
	R	.0400	.1088	.1450	.1487	.1700	
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0122	.0184	.0215	.0158	.0144	.0116
	S	.0046	.0052	.0205	.0053	.0038	.0032
	SE	.0011	.0011	.0045	.0011	.0008	.0007
	T*S	.0118	.0131	.0516	.0132	.0096	.0080
	R	.0538	.1050	.2000	.0800	.0512	.0500

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.	Apr.	May	June
5/57	X	.0126	.0176	.0175	.0177	.0236	.0180
	S	.0053	.0077	.0068	.0073	.0114	.0041
	SE	.0011	.0018	.0015	.0016	.0030	.0018
	T*S	.0134	.0196	.0171	.0183	.0298	.0138
	R	.0800	.0612	.1375	.0612	.0650	.0700
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0182	.0171	.0145	.0159	.0166	.0156
	S	.0081	.0066	.0051	.0064	.0048	.0087
	SE	.0018	.0014	.0012	.0013	.0011	.0020
	T*S	.0205	.0164	.0130	.0160	.0120	.0221
	R	.1325	.1163	.0688	.1313	.0700	.0650
		Jan.	Feb.	Mar.	Apr.	May	June
5/58	X	.0148	.0150	.0157	.0170	.0293	.0214
	S	.0032	.0048	.0045	.0071	.0210	.0123
	SE	.0007	.0011	.0010	.0015	.0056	.0028
	T*S	.0081	.0121	.0113	.0178	.0552	.0312
	R	.0388	.0950	.0775	.0887	.1350	.1575
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0195	.0145	.0139	.0138	.0112	.0145
	S	.0067	.0054	.0048	.0055	.0036	.0072
	SE	.0014	.0012	.0011	.0012	.0008	.0016
	T*S	.0169	.0136	.0122	.0138	.0092	.0180
	R	.0712	.0875	.0825	.0625	.0425	.1250
		Jan.	Feb.	Mar.	Apr.	May	June
5/59	X	.0088	.0096	.0148	.0199	.0220	.0127
	S	.0029	.0058	.0045	.0090	.0100	.0045
	SE	.0006	.0013	.0010	.0019	.0027	.0010
	T*S	.0073	.0148	.0114	.0225	.0263	.0114
	R	.0437	.0887	.0800	.2050	.1187	.0650
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0143	.0092	.0100	.0087	.0112	.0100
	S	.0078	.0036	.0053	.0040	.0049	.0034
	SE	.0017	.0008	.0011	.0008	.0012	.0007
	T*S	.0197	.0090	.0132	.0101	.0126	.0085
	R	.0988	.0450	.0588	.0487	.0325	.0825

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.	Apr.	May	June
5/60	X	.0081	.0086	.0108	.0122	.0278	.0091
	S	.0032	.0035	.0044	.0036	.0257	.0037
	SE	.0007	.0008	.0009	.0008	.0069	.0008
	T*S	.0081	.0090	.0110	.0091	.0674	.0092
	R	.0325	.0375	.0913	.0550	.1800	.0513
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0077	.0080	.0076	.0071	.0094	.0085
	S	.0042	.0025	.0038	.0027	.0025	.0035
	SE	.0009	.0006	.0008	.0006	.0006	.0007
	T*S	.0107	.0064	.0095	.0069	.0063	.0087
	R	.0363	.0363	.0387	.0350	.0400	.0363
		Jan.	Feb.	Mar.	Apr.	May	June
5/61	X	.0160	.0146	.0155	.0197	.0134	.0047
	S	.0146	.0058	.0103	.0094	.0063	.0021
	SE	.0032	.0013	.0022	.0021	.0016	.0004
	T*S	.0368	.0149	.0257	.0237	.0165	.0052
	R	.0950	.0725	.1500	.1137	.0675	.0287
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0066	.0055	.0058	.0056	.0096	.0092
	S	.0023	.0025	.0025	.0024	.0031	.0037
	SE	.0005	.0005	.0005	.0005	.0007	.0008
	T*S	.0059	.0062	.0063	.0060	.0078	.0093
	R	.0250	.0362	.0187	.0437	.0487	.0412
		Jan.	Feb.	Mar.			June
5/62	X	.0100	.0092	.0084			.0123
	S	.0052	.0037	.0034			.0054
	SE	.0011	.0008	.0007			.0012
	T*S	.0130	.0093	.0084			.0136
	R	.0600	.0525	.0400			.0925
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0123	.0101	.0080	.0099	.0069	.0066
	S	.0046	.0034	.0034	.0041	.0022	.0033
	SE	.0010	.0007	.0008	.0009	.0005	.0007
	T*S	.0117	.0086	.0087	.0104	.0056	.0084
	R	.0500	.0512	.0337	.0413	.0262	.0338

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.	Apr.	May	June
7/56	X	.0149	.0141	.0186	.0260	.0203	.0212
	S	.0063	.0072	.0101	.0081	.0078	.0076
	SE	.0014	.0016	.0022	.0018	.0017	.0017
	T*S	.0159	.0183	.0254	.0204	.0196	.0193
	R	.0600	.0825	.1425	.1175	.1237	.1000
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0214	.0179	.0214	.0142	.0136	.0121
	S	.0071	.0079	.0185	.0052	.0033	.0047
	SE	.0019	.0016	.0040	.0011	.0007	.0010
	T*S	.0187	.0197	.0466	.0131	.0084	.0119
	R	.0613	.1063	.2000	.0988	.0400	.0662
		Jan.	Feb.	Mar.	Apr.	May	June
7/57	X	.0123	.0167	.0144	.0140	.0147	.0191
	S	.0050	.0064	.0053	.0039	.0066	.0077
	SE	.0011	.0015	.0012	.0009	.0014	.0017
	T*S	.0125	.0163	.0133	.0099	.0166	.0195
	R	.0800	.0538	.1050	.0800	.0812	.1387
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0174	.0181	.0143	.0144	.0163	.0139
	S	.0098	.0059	.0039	.0064	.0052	.0072
	SE	.0025	.0013	.0009	.0013	.0012	.0016
	T*S	.0254	.0149	.0098	.0161	.0131	.0182
	R	.0775	.1488	.0588	.0950	.0787	.0575
		Jan.	Feb.	Mar.	Apr.	May	June
7/58	X	.0158	.0163	.0152	.0139	.0127	.0143
	S	.0050	.0069	.0071	.0045	.0052	.0048
	SE	.0011	.0015	.0016	.0010	.0011	.0010
	T*S	.0125	.0173	.0179	.0114	.0131	.0121
	R	.0550	.1025	.1000	.0638	.0550	.0413
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0198	.0138	.0123	.0148	.0112	.0138
	S	.0097	.0056	.0046	.0082	.0041	.0069
	SE	.0025	.0012	.0010	.0017	.0009	.0015
	T*S	.0252	.0140	.0115	.0206	.0103	.0173
	R	.1337	.0588	.0887	.0575	.0513	.1337

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.	Apr.	May	June
7/59	X	.0080	.0082	.0112	.0125	.0095	.0111
	S	.0035	.0036	.0048	.0051	.0041	.0057
	SE	.0008	.0008	.0010	.0011	.0009	.0012
	T*S	.0088	.0092	.0121	.0127	.0104	.0142
	R	.0350	.0600	.0475	.0538	.0475	.0525
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0098	.0104	.0107	.0078	.0111	.0095
	S	.0042	.0041	.0049	.0039	.0057	.0046
	SE	.0011	.0009	.0011	.0008	.0014	.0010
	T*S	.0108	.0103	.0122	.0097	.0146	.0117
	R	.0350	.0325	.0437	.0450	.0463	.0825
		Jan.	Feb.	Mar.	Apr.	May	June
7/60	X	.0054	.0070	.0060	.0059	.0073	.0058
	S	.0028	.0019	.0018	.0021	.0037	.0026
	SE	.0006	.0004	.0004	.0005	.0008	.0006
	T*S	.0070	.0049	.0045	.0052	.0093	.0065
	R	.0250	.0275	.0150	.0200	.0225	.0375
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0087	.0058	.0050	.0042	.0064	.0056
	S	.0019	.0022	.0021	.0022	.0021	.0022
	SE	.0005	.0005	.0005	.0005	.0005	.0005
	T*S	.0051	.0056	.0053	.0056	.0054	.0055
	R	.0450	.0238	.0263	.0188	.0262	.0200
		Jan.	Feb.	Mar.	Apr.	May	June
7/61	X	.0149	.0158	.0145	.0103	.0102	.0107
	S	.0074	.0102	.0075	.0059	.0040	.0065
	SE	.0016	.0023	.0016	.0013	.0008	.0014
	T*S	.0186	.0260	.0188	.0150	.0100	.0163
	R	.0913	.0875	.0925	.0375	.0538	.0813
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0160	.0084	.0063	.0079	.0126	.0077
	S	.0078	.0106	.0032	.0053	.0069	.0025
	SE	.0022	.0022	.0007	.0012	.0016	.0005
	T*S	.0206	.0264	.0081	.0134	.0176	.0063
	R	.0738	.0737	.0225	.0500	.0825	.0225

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.			
7/62	X	.0085	.0083	.0069			
	S	.0043	.0036	.0029			
	SE	.0009	.0008	.0006			
	T*S	.0108	.0091	.0073			
	R	.0550	.0462	.0250			
			Aug.	Sept.	Oct.	Nov.	Dec.
	X		.0114	.0078	.0087	.0060	.0055
	S		.0049	.0026	.0033	.0026	.0030
	SE		.0010	.0006	.0007	.0006	.0007
	T*S		.0124	.0065	.0082	.0065	.0077
	R		.0600	.0300	.0338	.0450	.0250
		Jan.	Feb.	Mar.	Apr.	May	June
9/56	X	.0146	.0142	.0195	.0269	.0203	.0213
	S	.0070	.0068	.0096	.0081	.0072	.0086
	SE	.0015	.0015	.0021	.0018	.0015	.0019
	T*S	.0177	.0172	.0241	.0205	.0181	.0217
	R	.0662	.0875	.1538	.1163	.1225	.1075
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0198	.0177	.0164	.0102	.0116	.0116
	S	.0084	.0057	.0091	.0053	.0038	.0051
	SE	.0018	.0012	.0030	.0012	.0008	.0011
	T*S	.0211	.0142	.0256	.0133	.0094	.0128
	R	.1525	.0800	.0737	.0863	.0437	.0638
		Jan.	Feb.	Mar.	Apr.	May	June
9/57	X	.0119	.0168	.0145	.0143	.0148	.0186
	S	.0054	.0069	.0057	.0049	.0078	.0077
	SE	.0011	.0016	.0013	.0011	.0017	.0017
	T*S	.0135	.0175	.0144	.0123	.0195	.0195
	R	.0788	.0550	.1025	.0775	.0813	.1475
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0195	.0157	.0138	.0133	.0141	.0128
	S	.0079	.0053	.0056	.0070	.0044	.0073
	SE	.0017	.0011	.0015	.0015	.0010	.0016
	T*S	.0199	.0134	.0148	.0174	.0110	.0184
	R	.0688	.0600	.0863	.0887	.0775	.0513

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.	Apr.	May	June
9/59	X	.0075	.0078	.0111	.0124	.0095	.0107
	S	.0033	.0037	.0044	.0052	.0043	.0060
	SE	.0007	.0008	.0010	.0011	.0009	.0013
	T*S	.0083	.0093	.0112	.0130	.0107	.0151
	R	.0312	.0588	.0450	.0525	.0425	.0525
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0088	.0075	.0081	.0064	.0096	.0086
	S	.0028	.0028	.0032	.0026	.0038	.0037
	SE	.0006	.0006	.0009	.0005	.0009	.0008
	T*S	.0070	.0070	.0084	.0065	.0096	.0093
	R	.0413	.0300	.0375	.0462	.0412	.0725
		Jan.	Feb.	Mar.	Apr.	May	June
9/60	X	.0046	.0058	.0047	.0057	.0064	.0051
	S	.0028	.0015	.0021	.0021	.0032	.0021
	SE	.0006	.0003	.0004	.0005	.0007	.0004
	T*S	.0070	.0037	.0052	.0053	.0081	.0053
	R	.0225	.0300	.0200	.0175	.0200	.0338
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0044	.0037	.0026	.0024	.0048	.0043
	S	.0029	.0032	.0020	.0022	.0021	.0023
	SE	.0006	.0007	.0004	.0005	.0005	.0005
	T*S	.0073	.0082	.0050	.0056	.0053	.0059
	R	.0400	.0238	.0238	.0162	.0225	.0162
		Jan.	Feb.	Mar.	Apr.	May	June
9/61	X	.0155	.0158	.0152	.0087	.0085	.0105
	S	.0087	.0121	.0067	.0042	.0028	.0070
	SE	.0019	.0028	.0014	.0009	.0006	.0015
	T*S	.0219	.0307	.0167	.0107	.0070	.0177
	R	.0900	.0900	.0950	.0300	.0475	.0787
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0138	.0107	.0093	.0051	.0109	.0058
	S	.0043	.0039	.0045	.0042	.0055	.0030
	SE	.0010	.0008	.0012	.0009	.0012	.0007
	T*S	.0108	.0098	.0118	.0105	.0140	.0076
	R	.0600	.0475	.0525	.0487	.0800	.0200

TABLE 3 - Continued

Futures Contract		Jan.	Feb.	Mar.	Oct.	Nov.	Dec.
9/62	X	.0081	.0071	.0062			
	S	.0042	.0038	.0029			
	SE	.0009	.0009	.0006			
	T*S	.0105	.0095	.0072			
	R	.0562	.0413	.0212			
	X				.0079	.0051	.0046
	S				.0029	.0030	.0026
	SE				.0006	.0006	.0006
	T*S				.0073	.0074	.0065
	R				.0363	.0188	.0225

TABLE 4

MEAN (X), STANDARD DEVIATION (S), STANDARD ERROR (SE), AND RANGE (R) OF THE DAILY PRICE VARIATION FOR CALENDAR YEARS 1966-1968. DATA PRESENTED IN DOLLARS.

Futures Contract		Jan.	Feb.	Mar.	Apr.	May	June
3/66	X	.0128	.0110	.0144	.0101	.0151	.0347
	S	.0056	.0057	.0146	.0147	.0075	.0196
	SE	.0025	.0027	.0071	.0068	.0034	.0087
	R	.0450	.0862	.0675	.0512	.1388	.2725
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0266	.0199	.0341	.0259	.0244	.0183
	S	.0110	.0080	.0168	.0135	.0070	.0069
	SE	.0052	.0035	.0076	.0061	.0033	.0031
	R	.1300	.0962	.2812	.1188	.1275	.1062
		Jan.	Feb.	Mar.	Apr.	May	June
5/66	X	.0147	.0126	.0140	.0151	.0173	.0369
	S	.0064	.0054	.0057	.0054	.0056	.0246
	SE	.0029	.0026	.0025	.0025	.0032	.0149
	R	.0562	.0838	.0820	.0775	.0800	.2525
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0276	.0201	.0347	.0268	.0241	.0214
	S	.0095	.0083	.0126	.0146	.0095	.0124
	SE	.0045	.0036	.0057	.0066	.0044	.0031
	R	.1400	.1150	.1650	.1225	.1488	.1062
		Jan.	Feb.	Mar.	Apr.	May	June
7/66	X	.0144	.0104	.0104	.0122	.0169	.0389
	S	.0077	.0052	.0052	.0034	.0085	.0335
	SE	.0035	.0025	.0023	.0016	.0039	.0148
	R	.0825	.0612	.0500	.0650	.1250	.2800
		July	Aug.	Sept.	Oct.	Nov.	Dec.
	X	.0227	.0261	.0329	.0242	.0263	.0221
	S	.0089	.0130	.0162	.0080	.0100	.0080
	SE	.0053	.0056	.0074	.0036	.0046	.0036
	R	.1288	.1550	.2600	.0925	.1762	.0450

TABLE 4 - Continued

Futures contract		Jan	Feb	Mar	Apr	May	June
9/66	X	.0133	.0114	.0120	.0113	.0163	.0363
	S	.0785	.0071	.0039	.0041	.0075	.0255
	SE	.0036	.0034	.0017	.0019	.0034	.0113
	R	.0825	.0588	.0500	.0632	.1300	.275
		July	Aug	Sept	Oct	Nov	Dec
	X	.0249	.0209	.0252	.0201	.0246	.0219
	S	.0109	.0101	.0100	.0072	.0085	.0085
	SE	.0051	.0044	.0057	.0033	.0040	.0049
	R	.1275	.0962	.1200	.0800	.1762	.0625
		Jan	Feb	Mar	Apr	May	June
12/66	X	.0118	.0109	.0120	.0112	.0162	.0357
	S	.0797	.0044	.0040	.0032	.0075	.0267
	SE	.0036	.0021	.0017	.0015	.0034	.0118
	R	.0775	.0600	.0488	.0632	.1332	.2062
		July	Aug	Sept	Oct	Nov	Dec
	X	.0276	.0209	.0354	.0267	.0243	.0219
	S	.0103	.0094	.0187	.0102	.0077	.0085
	SE	.0048	.0041	.0085	.0046	.0036	.0049
	R	.1250	.0975	.2800	.1162	.1200	.0625
		Jan	Feb	Mar			
3/67	X	.0211	.0234	.0235			
	S	.0083	.0099	.0123			
	SE	.0019	.0023	.0032			
	T·S	.0211	.0253	.0321			
	R	.1638	.1737	.1300			
		Jan	Feb	Mar	Apr	May	June
3/68	X	.0105	.0087	.0121	.0216	.0197	.0180
	S	.0043	.0023	.0054	.0093	.0054	.0096
	SE	.0009	.0005	.0015	.0021	.0014	.0020
	T·S	.0108	.0058	.0143	.0236	.0141	.0241
	R	.0363	.0450	.0837	.1812	.0637	.2087

TABLE 4 - Continued

Futures contract		July	Aug	Sept	Oct	Nov	Dec
3/68	X	.0193	.0199	.0175	.0131	.0142	.0114
	S	.0056	.0102	.0097	.0038	.0059	.0033
	SE	.0013	.0021	.0027	.0008	.0013	.0007
	T·S	.0143	.0255	.0258	.0096	.0149	.0083
	R	.0825	.1287	.0650	.0475	.0950	.0512
					Apr	May	June
3/69	X				.0161	.0108	.0131
	S				.0050	.0044	.0046
	SE				.0012	.0009	.0010
	T·S				.0128	.0109	.0116
	R				.1750	.0487	.1025
		July	Aug	Sept	Oct	Nov	Dec
	X	.0135	.0161	.0161	.0167	.0140	.0126
	S	.0061	.0075	.0048	.0076	.0049	.0051
	SE	.0013	.0016	.0011	.0016	.0011	.0011
	T·S	.0153	.0187	.0120	.0191	.0125	.0128
	R	.0700	.0837	.0750	.0988	.0725	.0613
		Jan	Feb	Mar	Apr	May	June
5/67	X	.0207	.0222	.0284	.0259	.0193	
	S	.0090	.0077	.0118	.0117	.0046	
	SE	.0020	.0018	.0025	.0026	.0012	
	T·S	.0226	.0194	.0297	.0295	.0120	
	R	.1575	.1687	.1475	.2175	.0675	
		Jan	Feb	Mar	Apr	May	June
5/68	X	.0105	.0081	.0123	.0161	.0122	.0160
	S	.0044	.0031	.0051	.0044	.0048	.0083
	SE	.0009	.0007	.0011	.0010	.0012	.0018
	T·S	.0109	.0078	.0128	.0111	.0126	.0209
	R	.0413	.0363	.0925	.1488	.0550	.1950

TABLE 4 - Continued

Futures contract		July	Aug	Sept	Oct	Nov	Dec
5/68	X	.0203	.0195	.0154	.0134	.0143	.0115
	S	.0053	.0103	.0082	.0042	.0057	.0033
	SE	.0012	.0021	.0018	.0009	.0012	.0007
	T·S	.0133	.0257	.0207	.0104	.0142	.0082
	R	.0862	.1225	.1050	.0437	.0900	.0575
							June
5/69	X						.0137
	S						.0049
	SE						.0011
	T·S						.0124
	R						.0975
		July	Aug	Sept	Oct	Nov	Dec
5/69	X	.0125	.0156	.0158	.0166	.0134	.0127
	S	.0055	.0077	.0048	.0090	.0050	.0052
	SE	.0012	.0016	.0011	.0019	.0012	.0011
	T·S	.0139	.0193	.0120	.0224	.0128	.0132
	R	.0675	.0987	.0688	.1012	.0688	.0550
		Jan	Feb	Mar	Apr	May	June
7/67	X	.0199	.0227	.0274	.0246	.0209	.0199
	S	.0093	.0076	.0118	.0100	.0085	.0119
	SE	.0021	.0017	.0025	.0022	.0018	.0025
	T·S	.0235	.0192	.0295	.0254	.0214	.0297
	R	.1237	.1625	.1375	.1862	.0738	.2475
		July					
7/67	X	.0190					
	S	.0046					
	SE	.0013					
	T·S	.0123					
	R	.0638					

TABLE 4 - Continued

Futures contract		Jan	Feb	Mar	Apr	May	June
7/68	X	.0097	.0078	.0124	.0166	.0115	.0144
	S	.0040	.0034	.0058	.0057	.0039	.0047
	SE	.0009	.0008	.0013	.0013	.0008	.0011
	T·S	.0101	.0086	.0147	.0143	.0098	.0120
	R	.0425	.0237	.0863	.1400	.0400	.1125
		July	Aug	Sept	Oct	Nov	Dec
7/68	X	.0110	.0177	.0150	.0122	.0121	.0105
	S	.0050	.0091	.0073	.0038	.0061	.0035
	SE	.0013	.0019	.0016	.0008	.0013	.0008
	T·S	.0131	.0228	.0186	.0096	.0154	.0089
	R	.0487	.1050	.0712	.0400	.0737	.0538
			Aug	Sept	Oct	Nov	Dec
7/69	X		.0139	.0149	.0142	.0133	.0120
	S		.0060	.0047	.0056	.0049	.0055
	SE		.0013	.0010	.0012	.0011	.0012
	T·S		.0152	.0118	.0141	.0125	.0138
	R		.1063	.0662	.1088	.0712	.0538
		Jan	Feb	Mar	Apr		June
9/67	X	.0193	.0234	.0275	.0275		.0235
	S	.0087	.0081	.0124	.0106		.0105
	SE	.0020	.0019	.0026	.0075		.0025
	T.S	.0220	.0206	.0310	.0739		.0269
	R	.1238	.1650	.1425	.0550		.1900
		July	Aug	Sept			
9/67	X	.0217	.0205	.0194			
	S	.0103	.0119	.0055			
	SE	.0022	.0025	.0012			
	T·S	.0259	.0298	.0140			
	R	.0862	.2425	.0787			

TABLE 4 - Continued

Futures contract		Jan	Feb	Mar	Apr	May	June
9/68	X	.0094	.0074	.0130	.0159	.0114	.0131
	S	.0042	.0030	.0069	.0059	.0042	.0045
	SE	.0009	.0007	.0015	.0013	.0009	.0010
	T·S	.0106	.0075	.0175	.0149	.0106	.0115
	R	.0375	.0238	.0875	.1462	.0437	.1088
		July	Aug	Sept	Oct	Nov	Dec
9/68	X	.0134	.0148	.0141	.0103	.0118	.0099
	S	.0051	.0057	.0044	.0039	.0060	.0036
	SE	.0011	.0012	.0012	.0008	.0013	.0008
	T·S	.0128	.0144	.0117	.0098	.0151	.0091
	R	.0825	.0938	.0575	.0388	.0750	.0538
		Jan	Feb	Mar	Apr	May	June
12/67	X	.0184	.0229	.0288	.0222	.0210	.0204
	S	.0085	.0081	.0145	.0102	.0086	.0108
	SE	.0019	.0019	.0031	.0023	.0018	.0023
	T·S	.0216	.0206	.0363	.0257	.0215	.0270
	R	.1250	.1625	.1450	.1462	.0750	.2275
		July	Aug		Oct	Nov	Dec
12/67	X	.0199	.0193		.0294	.0143	.0129
	S	.0055	.0079		.0027	.0057	.0038
	SE	.0012	.0016		.0019	.0014	.0008
	T·S	.0139	.0198		.0185	.0147	.0095
	R	.0800	.1350		.0400	.0650	.0525
		Jan	Feb	Mar	Apr	May	June
12/68	X	.0091	.0077	.0127	.0157	.0116	.0134
	S	.0044	.0028	.0062	.0054	.0046	.0039
	SE	.0009	.0007	.0014	.0012	.0010	.0009
	T·S	.0111	.0072	.0156	.0136	.0115	.0098
	R	.0363	.0212	.0875	.1425	.0475	.0988

TABLE 4 - Continued

Futures contract		July	Aug	Sept	Oct	Nov	Dec
12/68	X	.0140	.0153	.0162	.0168	.0137	.0167
	S	.0044	.0059	.0047	.0067	.0042	.0069
	SE	.0009	.0013	.0010	.0014	.0010	.0019
	T·S	.0109	.0147	.0118	.0168	.0107	.0182
	R	.0825	.0950	.0763	.1013	.0612	.0925

limit his loss to a specified dollar amount. Second, prices of different commodities exhibit different trading patterns. Third is the degree of uncertainty manifest in the economy. These factors should be considered as a whole rather than individually. Frequently a decision is based on a specified dollar amount, the loss of which the investor feels he can absorb. Often, this dollar amount is less than the initial margin requirement. The stop-loss order is not set, then, in regard to the normal daily fluctuations of the commodity contract and it might have the undesired effect of closing out the contract prematurely. In other words, an investor could buy a September wheat contract for $1.49 a bushel and at the same time place a stop-loss order at $1.45. If the contract fell to $1.45, the contract would be sold at the market (the price available when the order reaches the trading pit). The pit is the term used for the place where the auction occurs. It is assumed that the contract is sold at the price stipulated in the stop-loss order and the investor sustains a loss of $.04 a bushel. Since the contract calls for 5,000 bushels, his loss is $200 plus the commission of $22 for the round trip. A round trip with respect to a long position is the initial purchase and the consequent sale of the contract. Many contracts exhibit a daily fluctuation of $.04 several times a month without changing the price trend of the contract. The investor might have correctly judged the trend for the contract and would have profited from his long position had it not been for his stop-loss order. For many contracts the stop-loss distance set by the investor is more than adequate. For this particular contract, though, it was inadequate.

Tables 3 and 4 have been developed to help preclude the stopping out of a contract due only to normal daily fluctuations. The Fortran program used for the data presented in Tables 3 and 4 is given in Appendix A-2. The data for these tables came from an annual publication of the Chicago Board of Trade. This publication has the daily high, low, close 1, and close 2 (split close) prices of wheat for all contracts during the year. The split close occurs when the trading day has ended and two sales occur almost simultaneously at different prices. The last two sales of the trading day are then published.

In Tables 3 and 4, the low price was subtracted from the high price for each day's trade for each contract. For each contract, the arithmetic mean (X) for one calendar month was computed for this price difference. For the March, 1959 contract the mean of the daily price differences in December, 1958 was .9583 points. A point in the commodity market is one cent, i.e., a point is worth $50 per contract. For convenience, all data in Tables 3 and 4 has been converted to the dollar system. The figure X = .0125 in the May, 1969 contract in July, 1968 refers to a 1-1/4 point mean variation. The March, 1969 contract in December, 1968 had an arithmetic mean variation of 1.2560 points. The standard deviations of daily price movements for the two months respectively was .3778 and .5100.

This quantitative information can then be employed in our decision-making process by establishing a confidence interval for each contract as of a particular date. The investor would set the confidence limits according to the probability he feels is necessary to include the true value of the variable within those limits in the long run. In the following example, the 0.98 confidence level is used. Since the sample data for any month contains no more than 23 bits of information, the Student's t distribution is adopted for establishing confidence intervals. Some months have fewer than 23 trading days because of weekends and holidays. The delivery month has still fewer trading days since no trades are allowed during the last seven days of that month.

Mechanics of the Stop-Loss

Continuing with the March, 1969 contract on December 16, 1968, a stop-loss for a long position could be set at 136.5 if the investor used the close 1 price of 137.75 as his purchase price. Other striking prices could be assumed, but the close 1 will serve for illustration. Certainly, the mean price of the subsequent day would be the appropriate mean to use for his confidence interval, but we would still be using a subjective point estimate. The formula used for the above calculation is $\overline{X} - t_{.010}(s)$ = the stop-loss point, where $\overline{X}$ is the close 1 price. December, 1968, had 21 trading days and a t value of 2.528 using n-1 degrees of freedom. Substituting, the formula reads 137.75 - 2.528(.51) = 136.461. For some months, such as the December, 1966 contract in June, 1966 a stop-loss of 5.5 points below the previous day's close is implied with a 0.95 confidence interval, since 2.08(2.67) = 5.5536. In marked contrast is the December, 1966 contract in February, 1966 where a stop-loss of 1.0 below the striking price would be used, 2.101(.44) = .9244. The downside probability of being stopped out for the last two examples is statistically equated at the $t_{.025}$ level (the t value for small samples at the 5 per cent level) but the absolute dollar loss is considerably different. The dollar loss of the first example is 5.5 x $50 = $275 plus brokerage costs which is about 60 per cent of the margin requirement. The dollar loss of the second example is 1.0 x \$50 = \$50 plus brokerage costs.

The standard error of the mean (s_e) is also presented in Tables 3 and 4 in order to aid the investor in establishing his stop-loss point. Where $s_e = t_{.010}\ s/n^{\frac{1}{2}}$ and the confidence interval at the 0.98 level for the true population mean (u) is given by $X - t_{.010}\ s/n > u < X + t_{.010}\ s/n^{\frac{1}{2}}$.[1] In order for Tables 3 and 4 to be of value, it is necessary to determine if these statistics hold over time. Is the s for the March, 1966, contract in December, 1965, applicable to the March, 1969, contract in December, 1968? By examining the standard error of the mean, the investor can determine whether the arithmetic means for other dates and other contracts come from the same population. It is apparent from examining the statistics that the means are significantly different.

Tables 5 and 6 present the mean values for each of the options over all months and years in the study. These mean values may be employed as *ex ante* data for current decision-making. Other approaches could be developed to explore the possibility of statistical populations dependent on states of nature, previous years, or other possible correlations.

The Population Standard Deviation

Table 5 aligns the data according to the starting date of the contract. The delivery month is the last month for each contract. The method of presentation is similar to that of the theoretical bond yield curve, and is based on the same rational. The theoretical bond yield

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[1]John Freund and Frank J. Williams, *Elementary Business Statistics*, Prentice Hall, Inc., Englewood Cliffs, New Jersey, 1964, p. 245.

TABLE 5

THE ARITHMETIC MEAN OF THE STANDARD DEVIATION OF PRICE VARIATION FOR EACH CALENDAR MONTH FOR FOUR WHEAT CONTRACTS FOR THE YEARS 1956-62. DATA PRESENTED IN POINTS (1/100 OF A DOLLAR)

March Contracts

Apr	May	June	July	Aug	Sept
.487	.495	.565	.526	.427	.536
Oct	Nov	Dec	Jan	Feb	Mar
.460	.374	.487	.497	.5714	.967

May Contracts

June	July	Aug	Sept	Oct	Nov
.535	.547	.417	.649	.434	.356
Dec	Jan	Feb	Mar	Apr	May
.471	.560	.534	.551	.787	1.65

July Contracts

Aug	Sept	Oct	Nov	Dec	Jan
.589	.569	.493	.427	.444	.594
Feb	Mar	Apr	May	June	July
.569	.564	.493	.523	.582	.675

September Contracts

Oct	Nov	Dec	Jan	Feb	Mar
.403	.400	.40	.557	.580	.523
Apr	May	June	July	Aug	Sept
.490	.506	.628	.518	.403	.514

TABLE 6

THE ARITHMETIC MEAN OF THE STANDARD DEVIATION OF PRICE VARIATION FOR EACH CALENDAR MONTH FOR THE FIVE WHEAT CONTRACTS FOR THE YEARS 1966-68. DATA PRESENTED IN POINTS.

March Contracts

Apr	May	June	July	Aug	Sept
.967	.577	1.127	.757	.857	1.043
Oct	Nov	Dec	Jan	Feb	Mar
.830	.593	.51	.6067	.5953	1.077

May Contracts

June	July	Aug	Sept	Oct	Nov
.448	.677	.877	.853	.927	.673
Dec	Jan	Feb	Mar	Apr	May
.697	.660	.540	.753	.717	.50

July Contracts

Aug	Sept	Oct	Nov	Dec	Jan
.937	.940	.58	.70	.7133	.699
Feb	Mar	Apr	May	June	July
.540	.760	.637	.697	1.67	.549

September Contracts

Oct	Nov	Dec	Jan	Feb	Mar
.6266	.683	.670	.692	.607	.773
Apr	May	June	July	Aug	Sept
.687	.723	.333	.95	.9233	.66

December Contracts

Jan	Feb	Mar	Apr	May	June
.696	.51	.823	.653	.690	1.38
July	Aug	Sept	Oct	Nov	Dec
.6733	.773	.735	.653	.587	.64

curve is upward sloping as the length of time until maturity increases. The theoretical slope is based on the assumption that the more distant an item is, the less certainty is attached to its final value. Theoretically, then, we find interest rates for 20 year bonds are higher than 3 year bonds or any other time period from 0 to 20 years maturity. For some years, however, the bond yield curve has sloped downward due to other factors affecting interest rates. The same question is then posed for commodity contracts, "Shouldn't near term expirations for all contracts have similar expected yields and similar risk?" The discussion on expected yields is in a subsequent section. It is assumed in the following discussion that risk is measured by the variation in commodity prices for a month's time period. The closest delivery months, theoretically, should have a narrower variation of price change because supply and demand factors are subject to better estimates than they are for the more distant options. If an investor buys a March, 1970, option in March, 1970, then his expected risk should be less than if he had purchased the same option in April, 1969. The same reasoning should apply to the months in which wheat is harvested. At the termination of harvest (June - September) a better estimate is available of supply.

The crop year for wheat begins on July 1. Government statistics assume all wheat from the old crop year is harvested by July 1. The price variation in August and September for the July contract should be greater than in July, the month in which the wheat is assumed to be completely harvested.

Examining the data in Table 5, a difference in price variation is noted for the delivery month of the contract as contrasted to the price variation several months prior to the delivery month. An example is the March contract in March, with a $\sigma \cong .90$ and an August, September, October, and November $\sigma \cong .40$. The other delivery months are similar to the March delivery, with the delivery month exhibiting wide gyrations in price variation.

A similar pattern exists for the May option except that the delivery month has an even greater σ. The average for this month is greater than 1.50 points. The same four months of August, September, October, and November have a $\sigma \cong .40$. A pattern of price variation is established and greater risk is apparent in the delivery month than in other months.

The data in Table 5 is contrasted with the data in Table 6. The two tables contain the same information except for the dates involved. Table 6 is based on the calendar years 1966, 1967, and 1968. The wheat contracts have a fiscal year; for example, the 1967 March contract begins April 1, 1966, and ends March 21, 1967.

The price of wheat has gradually fallen over the 1952 to 1969 period. The quantity of wheat produced has increased greatly on continually shrinking acreage. The prices in 1958 were approximately $2.00 per bushel and in 1970 the price per bushel was as low as $1.40. With the change in price, a change in mean variation of prices should also occur, ceteris paribus. Other factors that might act to decrease mean variation are: government intervention, increased knowledge, and faster dissemination of information. The dollar value of the standard deviation would also change, but our decision criteria at the 98 per cent level would remain the same. The same number of standard deviations should be used in placing the stop-loss order.

If Tables 5 and 6 are examined in regard to the change in mean price variation, it is evident that the variation increases as the contract approaches maturity. The years 1966-1968 have a lower average price per bushel than the 1958-62 data, but the standard deviations for the same option contracts in the same month in the latter years exhibit greater price variation. Apparently, government programs, data processing equipment, and other forms of improved communications, have not decreased the risk attached to the contracts over the time period under study.

The five futures contracts should have prices that move approximately equally. Wheat can be stored with little loss in quality and, therefore, the contracts should sell only at a price difference due to the cost of storage and insurance. Whenever the differences between the prices of any two contracts becomes greater than the transaction costs (brokerage fees, taxes, carrying costs, grade differentials, etc.) an arbitrage situation exists for investors. The action of the investors, except for spot months, will drive the prices of the futures contracts back into alignment. In reality, the delivery contracts often sell at premiums or discounts from each other that are in excess of transaction costs for periods of time weeks and months in length.

The distribution presented in Table 7 is the arithmetic mean of the σ's of purchase month with regard to its time distance from the delivery month. The month following the delivery month is designated as the 11th month, the 2nd month following the delivery month is the 10th month, etc. The delivery month is designated as the 0 month. The 11, 10, . . . 0 represent the number of months until delivery. Table 7 has not differentiated according to contracts, but it has taken the

TABLE 7

ARITHMETIC MEAN OF THE STANDARD DEVIATION OF PRICE VARIATION FOR THE PURCHASE MONTH WITH RESPECT TO THE TIME DISTANCE TO THE DELIVERY MONTH. DATA PRESENTED IN POINTS.

Purchase Month Distance From Delivery Month	Calendar Years 1958-61	Calendar Years 1966-68
0 Months	.9515	.685
1 Month	.589	.899
2 Months	.522	.731
3 Months	.535	.551
4 Months	.501	.702
5 Months	.497	.685
6 Months	.502	.914
7 Months	.471	.739
8 Months	.539	.731
9 Months	.468	.815
10 Months	.502	.677
11 Months	.503	.645

arithmetic mean over all contracts on the assumption that a pattern exists according to the distance from the delivery month. In the 0 month, the arithmetic mean of the σ's is considerably greater than other months. It is also apparent that the 6th month is the low value and that the values tend upward from that point for the 1958-61 period. The 1966-68 data shows months 1 and 6 as the months with the greatest variation. It is evident that a trend of price variation does not exist in this latter group with respect to the distance in time from the purchase month until the delivery month. It is also evident that the standard deviation for price variation is also greater in the latter years.

Tables 3 through 7 have other ramifications. Not only do they benefit the investor, but the tables also help the brokerage house. These houses have relied on the margin as a security deposit for fulfillment of the futures contract. Apparently some contracts are not as secure as others. A sliding scale of margin requirements needs to be established for each of the five delivery months and the months of purchase. Too many gradations would make the administration of the margin unwieldy. Three or four categories would be adequate as a compromise between administering the margin and the relation of risk to required margin.

Summary

Tables 3 through 7 are based on price variations for wheat contracts in selected years. The earlier data is based on daily prices for March, May, July, and September contracts for the calendar years 1956-62. The September, 1958, and December 1956-1962 option contract price data were not in suitable form for processing on the IBM 360 and were omitted from the study. The later data is based on daily prices for the five wheat contracts for the calendar years 1966-68.

Commodity traders find the price statistics based on the data useful in establishing risk for wheat contracts at different points in time. Certain wheat contracts exhibit more variation than other wheat contracts of the same month but in a different crop year. The non-normal price variation tends to stay non-normal throughout the length of the contract. In statistical quality control, control limits are set for a specified confidence limit. Tables 3 and 4 contain Student's t value at the .98 confidence level multiplied by the standard deviation as an aid in setting a confidence limit.

Some months, such as June, July, and August, exhibit greater than average price variation for each of the five wheat contracts. They are the harvesting months for wheat, and traders' positions are adjusted by the extent of the anticipated harvest.

The last few days of a contract usually experience greater price movement due to the "evening up" process than do other periods. In order to isolate this price movement, two strategies are discussed and empirically tested in a subsequent chapter.

CHAPTER VI

RANDOM SELECTION STRATEGIES

Introduction

Every investor must have some criteria by which he may judge the progress of his investment strategy. In order to provide one guideline, several random selection strategies are developed. The random method attempts to eliminate all decisions that might bias the return on an investment. If the investor's strategy cannot outperform a random program, it certainly cannot be considered successful.

The first random strategy is based on the last five trading days of each option. Another strategy eliminates the first five trading days and the last five trading days of an option. Another set of random strategies involves the random selection of a purchase date for a particular option. The purchase date and the last day of trading in the contract determine the time period the contract is held. A filter rule based on the risk classes developed in Chapter V is applied to the purchase date strategy for both the long and short strategies of an investor. Annual rates of return are calculated for each strategy.

Five-Day Strategies

Certain time periods appear to exhibit greater price variation than other periods. One such time period is the last five days of a contract. The concept of the futures contract is responsible for the wide price gyrations in the last few trading days in the delivery month of the option. The total number of futures contracts outstanding at any one point in time often differs from the amount of wheat that will be available. Contracts must be settled sometime during the trading days of the delivery month. If there are more contracts outstanding than the available supply of wheat, some speculators will reap large profits, while others suffer losses. The price of the commodity is likely to change as actual supply is determined. The speculators who had sold the contract (promised to deliver) are now forced into buying the contract back from a speculator who had taken a long position. The opposite situation can also occur, as the available supply can be greater than the number of contracts outstanding. It is the speculator with the long position who finds he has paid more for the futures wheat contract than the cash market dictates at the time of delivery.

The program for determining the values in Table 8 is presented in Appendix A, Program A-4. Two strategies are presented in Table 8. Both strategies calculate the dollar profit and rate of return for each contract in the study. Due to the method of recording the data, those contracts on each end of the contracts under study contain fewer days of daily price information. The data were recorded on a calendar year basis as published by the Chicago Board of Trade. The price data for a futures contract (except December), overlap into another calendar year. Table 9 presents the number of days in each contract. The code in the second column represents the type of contract and the date. The 1 in the first position of the code represents wheat, the last 4 digits represent the delivery month and year of the contract. This code is followed on all programs.

TABLE 8

DOLLAR PROFIT AND RATE OF RETURN FROM SPECIFIC SELECTION STRATEGIES BASED ON A LONG POSITION

Strategy	Delivery Month Code	Dollar Profit	Rate of Return
1	10356	$759.25	1.61
2	10356	446.75	32.34
1	10357	628.00	1.31
2	10357	-509.50	-50.75
1	10358	328.00	0.69
2	10358	-272.00	-25.35
1	10359	278.00	0.58
2	10359	15.50	1.51
1	10360	128.00	0.27
2	10360	134.25	13.37
1	10361	696.75	1.45
2	10361	-278.25	-27.16
1	10362	146.75	0.31
2	10362	-15.75	-1.55
1	10556	1190.50	2.49
2	10556	-359.50	-32.21
1	10557	321.75	0.67
2	10557	-90.75	-8.31
1	10558	465.50	0.97
2	10558	265.50	26.13
1	10559	-140.75	-0.29
2	10559	-378.25	-36.92
1	10560	684.25	1.43
2	10560	-728.25	-71.95
1	10561	-484.50	-0.01
2	10561	-40.75	03.99
1	10562	59.25	0.12
2	10562	46.75	3.95
1	10755	-209.50	-2.51
2	10755	-59.50	-0.29
1	10756	1234.25	2.57
2	10756	-215.75	-21.32
1	10757	-222.00	-0.46
2	10757	78.00	7.55
1	10758	-584.50	-1.22
2	10758	-322.00	-31.81
1	10759	-34.50	-0.07
2	10759	-22.00	-2.16
1	10760	178.00	0.37
2	10760	-153.25	-17.72

TABLE 8 - Continued

Strategy	Delivery Month Code	Dollar Profit	Rate of Return
1	10761	$ -3.25	-0.01
2	10761	328.00	32.14
1	10762	-159.50	-0.34
2	10762	53.00	3.58
1	10955	-378.25	-0.92
2	10955	-53.25	-1.19
1	10956	1453.00	3.03
2	10956	121.75	11.79
1	10957	-753.25	-1.57
2	10957	-190.75	-18.69
1	10959	59.25	0.12
2	10959	-22.00	-2.16
1	10960	284.25	0.59
2	10960	71.75	9.56
1	10961	521.75	1.09
2	10961	28.00	2.73
1	10962	-172.00	-0.37
2	10962	53.00	2.67
1	10367	-3.25	-0.01
2	10367	78.00	1.68
1	10368	90.50	0.19
2	10368	-147.00	-13.47
1	10369	-415.75	-0.88
2	10369	34.25	2.56
1	10567	-778.25	-1.74
2	10567	-84.50	-3.24
1	10568	59.25	0.12
2	10568	-128.25	-12.52
1	10569	-722.00	-1.55
2	10569	53.00	3.12
1	10767	-1265.75	-2.73
2	10767	134.25	7.41
1	10768	15.50	0.03
2	10768	-109.50	-10.73
1	10769	-190.75	-0.42
2	10769	3.00	0.13
1	10967	-1428.25	-3.03
2	10967	103.00	7.38
1	10968	9.25	0.02
2	10968	-84.50	-8.25

TABLE 8 - Continued

Strategy	Delivery Month Code	Dollar Profit	Rate of Return
1	10969	34.25	0.08
2	10969	-15.75	-0.40
1	11267	-1803.25	-3.76
2	11267	28.00	2.73
1	11268	-1684.50	-3.51
2	11268	303.00	29.57

The program for Strategy 1 calls for entering the computer data tape at the close 1 price of the fifth day of the contract. The contract is held until five days before the last trading day of the contract, and is assumed to be sold at the close 1 price on that day. As an example, Table 9 shows that the December, 1968 wheat contract had 244 trading days. The close 1 price on the fifth day of the contract (January 8, 1968) is 160 3/8 points, or $1.60375. The close 1 price on the 239th day of the contract is 127 1/8. The price difference between these two positions is 33 1/4 points. If the speculator had a long position, his loss is $.3325 x 5,000 bushels = $1,662.50 + $22 commission = $1,684.50. The $1,684.50 is the amount shown in Table 8 for Strategy 1 as dollar profit. A short position would require $22 to be subtracted from $1,662.50 for a positive profit of $1,640.50.

The rate of return is calculated by the following formula:

$$\text{Rate of Return} = \frac{\$\text{ Profit}}{\$500} \times \frac{\text{Number of trading days in contract}}{\text{Number of days in strategy}}$$

Continuing with the previous example:

$$\text{Percentage Rate of Return} = \frac{\$1{,}684.50}{\$500} \times \frac{244}{234} \times 100 = -351$$

The $500 is the speculator's investment in the contract (the assumed margin requirement).

The return on the investment is converted to an annual basis in order to facilitate comparisons to other strategies presented later. Of course, this rate of return can be converted to an annual percentage by multiplying by 100. No adjustments are made for taxes.

From examination of the data, the historical returns from Strategy 1 demonstrate the relatively large rate of return available in wheat futures contracts. The rate of return must be viewed from the position

TABLE 9

NUMBER OF TRADING DAYS DATA EMPLOYED IN THE STUDY BY CONTRACT

Trading Days	Contract Delivery Code
181	10356
249	10357
233	10358
243	10359
249	10360
244	10361
246	10362
224	10556
229	10557
246	10558
244	10559
247	10560
245	10561
211	10562
12	10755
247	10756
242	10757
247	10758
245	10759
289	10760
245	10761
169	10762
56	10955
242	10956
245	10957
245	10959
333	10960
244	10961
126	10962
54	10367
229	10368
187	10369
96	10567
244	10568
147	10569
138	10767
245	10768
106	10769
179	10967
244	10968
63	10969
244	11267
244	11268

of the speculator, as a positive return in Table 8 is a positive return for a long position, and a negative return in Table 8 is a positive return for a short position. Strategy 1 is designed to remove the large price movements that occur so often at the beginning and end of a contract.

Strategy 2 is designed to test the profits and rates of return during the last five days of a contract. It is assumed in Strategy 2 that the contract is purchased at the close 1 price on the fifth day before the end of the contract and sold at the close 1 price on the last day of the contract. Continuing with the previous example, it is assumed that a purchase is made on December 12, 1968, for the December, 1968 contract and sold on the last day of the contract (December 19, 1968). The dollar profit calculation is [($1.33 5/8 - $1.27 1/8) x 5,000] - $22 = $303.00.

A comparison of the annual rates of return for Strategies 1 and 2 underscores the profit potential of Strategy 2. It, also, underscores the risk of trading in the last few days of the contract if it can be assumed that risk and return are generally equated.

Table 10 reveals the arithmetic mean by contract of the annual rate of return for the years covered by the study. The arithmetic means for the seven years covered from 1955 to 1962 again demonstrate the very high average return available in wheat futures. No pattern is discernible from these *ex post* statistics for *ex ante* decision making. Under Strategy 1, the prices in the latter years (1967-68) are negative while the former years (1955-62) are mostly positive. For Strategy 2, the negative rates are evident in both sets of yearly data. A continuous short position in Strategy 2 could be suggested if

TABLE 10

MEAN RATE OF RETURN FOR EACH OF FOUR CONTRACTS OVER THE YEARS 1955-62 AND FIVE CONTRACTS 1967-68

Contracts	Mean Rate of Return	
	Strategy 1	Strategy 2
1955 - 62		
March	0.887	-8.226
May	0.626	-17.616
July	-0.209	-3.751
September	0.281	0.672
1967 - 68		
March	-0.232	-3.073
May	-1.054	-4.215
July	-1.039	-1.064
September	-0.975	-0.423
December	-3.637	16.153

the speculator had sufficient funds and mental stability to remain invested during the wide swings in price of the last five days.

The above strategies were selected by date. In the next section, the time constraint is removed and the dollar profit and rate of return are determined randomly.

Random Purchase Date Strategies

Strategy 1. The random selection computer program employed for this commodity study is presented in Appendix A, Program A-5. The program calls for selecting a date by a random method from the population of all trading dates in a contract. The close 1 price of the selected date is assumed to be the purchase (striking) price. The contract is held until its last trading day and is sold at the close 1 price on the last day of trading in the contract. The number of days the contract was outstanding is recorded and placed into one of twelve categories.

The class boundaries for these categories are: 0-5 days, 6-25 days, 26-45 days, 46-65 days, 66-85 days, 86-105 days, 106-135 days, 136-160 days, 161-185 days, 186-210 days, 211-235 days, and 236 days and over. The variable classes were selected to cover the time periods assumed to be of greatest importance to a speculator. These time periods are: (1) the first few trading days of a contract (class 0-5 days), (2) the trading days bounding the change in tax status of an investment from a short-term to a long-term capital gain (class 106-135 days), and (3) the last few trading days of a contract (class 236 days and over). All other classes are either 20 or 25 days in length in order to divide the remaining trading days into equal size classes.[1]

The number of days the contract is outstanding is determined by counting the trading days from the purchase date to the sale date.

The commodity contract for speculators is considered to be a capital asset, and gains or losses are taxed according to the rules governing capital items. A commodity contract held for over six months is considered taxable as a long term capital item. Hedgers and dealers have different taxation rules than do speculators, but the hedgers' and traders' transactions are only a minor part of the total transactions in the commodity futures market.

It must be kept in mind that these time classes are based on trading days and not calendar days. An investor can compare his investment program to this random program by converting his profits to an annual basis and determine the number of days he held the contract. The random program states that a March, 1957 contract held for over 235 days had an average rate of return of .131 for a long position with a standard deviation of .162. The very high standard deviation for the longer contracts in relation to the mean demonstrates the wide distribution associated with commodity contracts.

Very little statistical evidence is available for determining the distribution of various types of investments. Particular classes of investments have not been defined according to their expected mean annual rate of return and its standard deviation. The classes of investments could then be compared by an investor in determining which type(s) of investment class(es) best suit his needs.

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[1] Freund and Williams, _op. cit._, p. 12.

The description of means and standard deviations for the commodity contracts in Appendix B, Tables 1 and 2 is an attempt to provide quantitative answers to the amount of risk and return in the wheat futures market.

Due to the method of calculation, the rates of return for the earlier contracts under Strategy 1 are considerably greater than the rates of return on contracts for the longer time periods. The explanation involves the relatively large price changes in commodities on a daily basis compared to other less risky forms of investment. The large price movements generate large profits (losses) which are magnified by the turnover figure in the formula for the rate of return.

Total annual trading days is used instead of 365 calendar days because the time periods for the strategies are based on trading days. The time period 0-5 trading days could be from 0 to 10 calendar days. The study could be modified to present the rate of return on an annual calendar basis rather than on an annual trading day basis as employed in this study. Again, it must be mentioned that the rates of return can only be compared by referring to Table 9 which presents the number of trading days in each contract. Only the contracts with approximately the same number of trading days are really comparable.

In addition to providing a yardstick for measuring non-random programs, the statistical analysis provides a basis for comparing the rate of return by delivery month. The arithmetic mean of four options for the years 1955-62 is presented in Appendix B, Table 3-B. The delivery month is determined by the integer in the last column of the table. A 3 represents March, 5 is May, 7 is July, 9 is September, and 12 is December.

Examination of the 1955-62 data reveals that the May contract has a higher mean annual rate of return for the first nine time classes. It is only after 185 trading days that other delivery months show a higher mean average rate of return. The data also disclose that the May contract mean returns are all negative while all but one of the September contracts are positive.

The contracts should sell at a difference in price only to the extent of the cost of storage, insurance, and protein deterioration of the commodity. The March contract could be accepted for delivery and physically stored until the May delivery. The two contracts should sell by only the "carrying costs" difference.

The comparable dates in the latter years (1967-68) would be for the 1968 contracts which are complete fiscal year contracts. The contracts follow more closely for this one year (1969) to the fundamental concept of contracts selling only for a price differential due to "carrying charges," except for the September contract which again seems to follow a different pattern than the other deliveries. The September contract has positive rates of return 50 per cent of the time while the other contracts are almost all completely negative for all time periods. The statistics from Strategy 1 act as another input suggesting that the contracts are trading in an imperfect market.

Strategy 2. The second strategy introduces a filter rule to the random selection procedure of Strategy 1. The filter rule is based on the standard deviation of price variation discussed in the first section of Chapter 5.

The computer program (Appendix A, Program A-5) calls for employing the same dates as Strategy 1 in order to compare the results of the filter. Strategy 2 is assumed to be a long position, and the investor places a stop-loss order equal to the filter rule. The distance the stop-loss is set from the purchase price is based on the standard deviation for the same contract and the same month as the current purchase except that it is from the preceding year. As an example, a purchase on October 3, 1968, of the September, 1969, contract at 134 1/2 (close 1 price) would set a stop-loss at 133 1/2 since the standard deviation is .39 of a point for the September, 1968 contract. The t value is based on the number of trading days in the month. The t value is multiplied by .39 for a value of .98 of a point (the value used in setting the stop-loss). Should the price of September, 1969, wheat fall to 133 1/2 the sell order would be executed and the investor's loss would be limited to about $50 plus $22 in commissions. Should the low price of September wheat never reach the stop-loss order point, the contract would not be sold until the last day of the contract. The rates of return and standard deviations are calculated exactly as in Strategy 1.

Comparing the two strategies, it is clearly evident that the filter rule reduces the size of the loss of the investor with a long position and increases the size of his potential gain. Since the time periods under study show a loss for most contracts with a long position, it is apparent that a short position should have been adopted over the 1955-62 time period. But, had the investor made the incorrect decision of a long position, he would be ahead of Strategy 1 by employing Strategy 2 under all conditions.

Strategy 3. The third strategy assumed the investor has taken a short position. Again using the October 3, 1968, purchase date for the September, 1969, wheat contract, the investor sets his stop-loss at 1 point greater than his striking price. Should the price of September wheat rise to 135 1/2, his position would be stopped out at that point (a buy order would be placed for the short sale). Should the high price of September wheat not reach the stop-loss point, the position is assumed closed out on the last day of the contract.

Several time classes in Strategy 3 have a 0 value. The 0 value occurs because of the filter rule. Referring to Strategy 1 when it has a positive value throughout most of the time classes, a 0 is more likely to occur in the longer time period classes. With the filter rules and a rising market, all positions are closed out long before the end of the contract.

Summary

Five random selection strategies have been developed to serve as a relative measure to biased investment strategies. By eliminating the first five and last five trading days of an option, Strategy 1 of the five-day trading strategies attempts to remove extraordinary price movements. The annual rates of return for Strategy 1 range from a negative 375 per cent to a positive 257 per cent. Strategy 2 is based only on the last five days of a contract. The last five days historically exhibit extreme price variation and the annual rates of return from a negative 7195 per cent to a positive 3234 per cent reflect the wide price gyrations of this time period.

The other three strategies are based on a program with randomly selected purchase dates. The rate of return on a contract is converted to an annual rate to facilitate comparison to other time periods. The trading dates are divided into 12 time periods and a mean rate of return computed for each time period. Over all time periods the mean rate of return is slightly less than 0 as would be expected by the nature of a futures contract.

Another investment strategy is to adopt a filter rule which will limit an investor's downside risk and increase his likelihood for positive gains. The filter rule used in conjunction with the random selection program is based on the historical standard deviation for a particular futures contract in a specified calendar month.

The results of the filter for the two time periods in the study (1955-62 and 1967-68) reveal a reduction in the investor's downside risk and an increase in his profit.

The strategies and data developed for this chapter are used in an investment program based on Bayesian Analysis which uses sample data for adjusting historical probabilities concerning the states of nature in the commodity market.

CHAPTER VII

AN HEURISTIC PROGRAM FOR WHEAT SPECULATION

Introduction

There are thousands of plans for investing in capital assets. The decision to buy or sell an asset can be based on chart patterns, sun spots, intuition, or perhaps some formula timing plan. Most of these plans are based on historical events.

The method presented here is based on subjective probabilities. Statisticians for many years have argued about the value of employing subjective probabilities, but in order to use Bayes Theorem subjective probabilities are often necessary.

An explanation of Bayes Theorem is presented first along with a discussion of subjective probabilities. Variables beyond the control of the decision maker are known as States of Nature. The states of nature in this study are based on a distribution of percentage changes in the price of a bushel of wheat. Price changes have been correlated with production, weather, political announcements, Department of Agriculture announcements, and other demand/supply inputs.

The prior probabilities of Bayes Theorem in this study are based on historical probabilities for a specified distribution of rates of return. As the future distribution of the rates of return for the commodity market is not an objective certainty, the prior probabilities are subjective. The prior probabilities are adjusted by conditional probabilities using the price affecting random variables established through correlation analysis. The weighted prior probabilities (posterior probabilities) are then used for the decision of selecting a particular investment strategy.

Bayes Theorem

Decisions are based on the probability that certain events will occur. Should the decision involve the probability that a five will occur on the next roll of a fair six-sided die, the probability of a five is termed objective probability. If the sides of the die are not fair and the likelihood of occurrence of each face of the die is not known, the probability attached to the appearance of a five is termed subjective. Subjective probability is based on judgement or perhaps historical records.

Bayes Theorem starts with a prior probability, a probability based on judgement, historical data, or intuition. A sample is taken of the process under consideration and the probabilities of the variable occurring given the states of nature are computed. These conditional probabilities are used to adjust the prior probabilities for decision-making.

In order to derive Bayes Theorem, the following terminology should be understood:

$$P(A_i, B_j) = P(B_j)\ P(A_i|B_j) = P(A)\ P(B|A) \qquad [1]$$

where P(A,B), the joint probability, is the probability of the compound events A and B, i.e., a joint occurrence of both events A and B. P(B) is the probability of event B, and P(A|B) is the probability of event A occurring given that B has already occurred.

Solving equation [1] for $P(B_j|A_i)$ we have

$$P(B_j|A_i) = \frac{P(B_j)\ P(A_i|B_j)}{P(A_i)} \qquad [2]$$

Equation [2] is known as Bayes Theorem, where $P(B_i)$ in the numerator is known as the prior probability of a particular state of nature B_i, $P(A|B)$ is the conditional probability of event A given B, the entire numerator is the joint probability of $P(B_j)\ P(A_i|B_j)$, $P(A_i)$ is the sum over all joint probabilities, and $P(B_j|A_i)$ is the posterior probability. $P(A_i)$ can also be written

$$P(A_i) = \sum_j P(A_i,B_j) \qquad \text{or}$$

$$P(A_i) = \sum_j P(B_j)\ P(A_i|B_j)$$

since we substitute the formula for the compound probabilities of $P(A_i,B_j)$.

Development of the Data

In order to solve for $P(A|B)$, the conditional probability, the effect on price (A_i) by event B_j must be established. Event B_j is a variable affecting the price of a commodity contract.

The Wall Street Journal was used as the source of information concerning the variables that affect price. The Wall Street Journal has a daily column devoted to the factors affecting commodity prices. The information presented is subject to the bias of the reporter. It is assumed that the reporter presents specific information each day and does not editorialize. Other columns of the Wall Street Journal were also examined systematically to see if they contained any information that was pertinent to the study. An analysis of all variables affecting the price of wheat and the covariance of these variables would be almost an impossible task. A number of variables are taken into consideration in this study. The four main variables which summarize many factors are: (1) direct demand and supply variables, (2) weather, (3) the political climate, and (4) Department of Agriculture announcements and programs.

Under (1) demand and supply are listed exports or imports from foreign countries; the amount of rail cars available for wheat shipment during the harvest season; the change in wheat consumption per capita (such as would occur during diet fads). Under (2) weather is the amount of snow that fell on the winter wheat crop to act as a barrier against the cold weather; the amount of rain that fell during harvest time; the weather conditions for planting; major inclement weather such as floods, drought, etc.; the weather in wheat producing foreign countries, notably that of Canada and Australia; and any other factors that fall into this category. Under (3) political climate are such programs as Eisenhower's Food for Peace Plan in January, 1959, to utilize surplus grain; the use of surplus wheat in diplomacy; increased margin requirements for contracts; the possibility of war since wheat would be increased to provide a safety stock; and other factors that fall into this category. Under (4) Department of Agriculture is the change in price supports, acreage allotments, storage requirements; announcements concerning the expected amount of wheat to be produced; and other factors falling into this category.

For each day, the total price affecting information was examined and a value placed on that particular day. The values assigned are related inversely to the direction of price movement. Favorable weather during the planting season is indicative of a greater future supply of wheat than would be produced with unfavorable weather. Price falls with an increase in supply. The numerical values assigned to an expected price decrease are the integers 1 and 2. The integer 1 reflects a drop in price greater than the integer 2. The value 3 is for the days in which price affecting information did not occur, or that the information for that day was equally distributed between favorable and unfavorable news. The values 4 and 5 are similar to 1 and 2 except that the future supply of wheat is increased.

The price affecting information for each day is summarized by an integer which reflects the net demand or supply situation which exists for that day. The net demand or supply situation is determined by algebraically summing the numerical values of the individual price-affecting variables. The values assigned are subjective as must be the case in an area of decision-making influenced by so many variables. These values are used in determining the expected price movement of wheat. A high correlation of the numerical values assigned to the variables and the price of wheat is necessary for the Bayesian model to be valuable.

Price Correlation

Annual Price Correlations. The price of wheat is basically determined by demand and supply. Government subsidy programs also affect the price of wheat. Since rates of return are used as the prior probabilities for the states of nature (B_j), the investor must know why price changes of a specific degree and in a specific direction occur. A simple linear correlation for a number of variables such as acres planted, acres harvested, free supply, carryover, support prices, and the production of wheat with price was calculated. With 13 annual observations for the years 1957-1969, the price-productivity correlation has a value of r = -.7037. This correlation may be interpreted that as the number of bushels of wheat produced increased, the price per bushel decreased or price increased when the amount of wheat produced decreased. The correlation is high, but it is not the one to one relationship that is desired. It was expected that free supply would be very highly correlated with an r greater than -.80, but the correlation for the same 13 years produced an r = -.5138.

Daily Price Correlations. The high correlations of the annual demand/supply variables with annual wheat cash prices suggested that daily prices might be correlated with similar variables. The computer program (Appendix A, A-6) calls for a correlation of the four main variables of the study beginning with the daily wheat prices of the 1958 crop year.

The correlations of all four main variables: (1) direct demand and supply variables (D), (2) weather (W), (3) the political climate (P), and (4) Department of Agriculture announcements and programs (G) with the price of wheat on the day the news appeared in the Wall Street Journal is shown in the first column of Appendix D, Table 1-D. Correlations were run with the first three option contracts of 1958 to establish whether a high correlation existed and to serve as a basis for the examination of other time periods if such a correlation were established.

The DWPG column (Table 11) is subdivided into a column for the algebraic sum of the values for the four variables by day (daily) and a column for a running (cumulative) algebraic sum of the daily total. The closing price of wheat on the date of the appearance of the DPWG variable was correlated with the DPWG variable value ($r = .2187$). A correlation of $r = -.2010$ represents the relationship between the cumulative sum of the DWPG values and the closing price of wheat on the day prior to the appearance of the news item. If a high correlation for the previous day price and DWPG existed, it would suggest that investors are aware of the news items prior to publication of the information in the Wall Street Journal.

None of the correlations are high enough to warrant adoption in an investment program. The correlations could be low for several reasons. (1) The variables selected were not the critical variables. (2) The news items were biased. (3) The news items were incorrectly valued by the analyst. A further search is required to develop variables which are highly correlated to the States of Nature required in the model.

Prior Probabilities

In order to establish the probabilities of the states of nature, a list of events that is collectively exhaustive must be established. The assignment of a numerical weight to each event can then be established historically, subjectively, etc. The assignment of values for the commodity study is based on the random program presented as Strategy 1 (Random Purchase-Dates). The same time periods of 0-5 days, 6-25 days, etc., are kept as well as the same contracts.

TABLE 11

CORRELATION COEFFICIENTS (r) OF DAILY WHEAT PRICES
FOR THE MARCH, MAY, AND JULY, 1958, OPTIONS WITH
NEWS ITEMS CONCERNING FOUR CRITICAL VARIABLES

	D W P G*		D W*		P G*		D*	W*
	DAILY VALUE	CUMULATIVE VALUE	DAILY VALUE	CUMULATIVE VALUE	DAILY VALUE	CUMULATIVE VALUE	DAILY VALUE	DAILY VALUE
MARCH OPTION								
SAME DAY PRICE	0.22	-0.19	0.21	0.20	0.11	-0.25	-0.25	0.07
PRECEDING DAY PRICE		-0.20	0.17	0.21	0.01	-0.25	-0.19	0.07
MAY OPTION								
SAME DAY PRICE	0.19	-0.01	0.20	0.23	0.07	0.22	0.23	0.09
PRECEDING DAY PRICE		-0.01	0.17	0.23	0.04	0.22	0.17	0.08
JULY OPTION								
SAME DAY PRICE	0.16	0.31	0.11	0.22	0.13	-0.10	0.21	-0.04
PRECEDING DAY PRICE		0.30	-0.01	0.23	0.09	-0.11	0.06	-0.08

*Direct demand/supply affecting variables (D), weather conditions (W), the political climate (P), and announcements by the United States Department of Agriculture (G).

The information required for the prior probabilities is the frequency of occurrence of specified percentage changes. A percentage change is defined as the rate of return method of Strategy 1 of the random selection program. An example is the December, 1968, contract purchased on November 22, 1968, at the close 1 of 139 1/4 points. Since the contract had 18 trading days to run, it was placed in the second time period of 6-25 days. The contract is assumed sold on December 19, 1968, at the close 1 price of 135 5/8 points for a negative 5.625 point difference. By adding in the commission of $22, the loss on the one contract is $303.25. The loss is converted to an annual rate of return and counted as a member of a particular class of percentage changes. A total of 6,000 iterations comprises the frequencies used for Table 12 and for the tables in Appendix C.

A summary of all contracts over all time periods for the percentage of price change falling into the 14 classifications is presented in column 1 of Table 12. Column 2 is a summary of percentage changes for all contracts held for periods of time over 105 days. Column 2 was added to determine if the method of calculating the annual rate of return biased the shape of the distribution shown in column 1 through the higher turnover figure applied to the early time periods (periods 1-6). The shape of the distribution, though, remained bimodal with approximately the same percentages falling into each class.

The percentage change (rate of return) in column 1 from -50 per cent to +50 per cent contains 23.15 per cent of the price changes. In other words, a price change greater than 50 per cent occurred over 75 per cent of the time when viewed from either a long or a short position. The distribution is bimodal with each modal group bell shaped. The greatest frequency in both modal groups occurs in the 100 to 200 per cent price change category.

The distribution in Table 12 is remarkable from a standpoint other than the high rates of return; and that is the almost equal division between positive and negative changes. From an examination of the tables used in computing Table 12 (see Appendix C), the equal divisions do not exist for the separate contracts. The tables in Appendix C present the same information as Table 12 but in a more specific form. Appendix C, Tables 1-C through 4-C present the percentage distribution of 14 classes of rates of return for 12 time periods for each of the four contracts March, May, July, and September respectively. The distributions for these tables are not of the bimodal form of Table 12.

If an investor over the time period 1957-62 followed the random selection program presented in this paper, his expected value would be only slightly less than 0 due to 51.22 per cent of the values for the contracts held over 105 days falling into the negative return category. For contracts held over all time periods, 51.36 per cent fall in the negative return categories. The very wide distribution of price changes, i.e., over 58 per cent of the investor's assumed positions have a return of 50 per cent or greater from the striking price. With such a wide distribution, theoretically, the mean return should compensate for the risk of the wide price swings. From Table 12 over the data studied, it is apparent that there is no long-run return from assuming the random investment strategy employed here.

TABLE 12

PERCENTAGE DISTRIBUTION OF RATES OF RETURN OVER FOUR CONTRACTS 1957-62 FOR ALL TIME PERIOD CLASSIFICATIONS AND FOR ALL CONTRACTS HELD OVER 105 DAYS

Annual Rates of Return (in Percent)	Percentage of Occurrence	
	All Contracts	Contracts Over 105 Days
-1000 or less	3.92	0.0
-500 to 999	5.10	1.03
-200 to 499	10.73	11.67
-100 to 199	11.43	14.96
-50 to 99	9.05	10.19
-20 to 49	7.0	8.44
-0 to 19	4.13	4.93
+1 to 19	4.07	4.29
+20 to 49	7.95	9.52
+50 to 99	10.60	13.74
+100 to 199	11.88	14.09
+200 to 499	9.45	7.06
+500 to 999	3.40	0.05
+1000 and Greater	1.28	0.0

A well-known study by Fisher and Lorie regarding the rates of return of stocks listed on the New York Stock Exchange from 1926 to 1960 revealed an annual return of 9.00 per cent disregarding income taxes.[1] It would be expected that the commodity market with its greater risk would yield a higher rate of return. The answer to the apparent discrepancy is based on the nature of the futures option. It is a contract for the future delivery of a commodity for which the demand and supply at delivery can only be estimated. It would thus be expected that the long-run return would be slightly negative due to the brokerage fees for transactions. According to the results of this study, the makers of the contract have not continually overestimated or underestimated the future price of wheat.

Appendix C, Table 6-C is a summary of the frequencies for all contracts for the calendar years 1967-68. With only two calendar years, the data is biased from the standpoint of being weighted more toward the shorter time periods than the same calculations for the crop years 1957-62. Even with this bias, it is evident that the distribution of rates of return for the later years is narrower than for the years 1957-62.

The prior probabilities from Table 12 are weighted by the conditional probabilities from a sample of price affecting variables. The variables are established through a correlation analysis.

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[1]Lawrence Fisher and James H. Lorie, "Rates of Return on Investments in Common Stocks," in Frontiers of Investment Analysis, E. Bruce Fredrikson, editor, International Textbook Co., Scranton, Pennsylvania, p. 169.

Conditional Probability

The next step in Bayes Theorem is to establish the conditional probabilities of an event. The question to be answered is, "Given that the State of Nature is B_j, what is the probability that the sample contained A_i defectives, failures, successes, or whatever random variable is under analysis?"

The States of Nature (Table 13) are the rates of return available in the commodity market. The B_j are classified according to a specified change in the price of a bushel of wheat. The critical variables of the study (the variables which affect the price of wheat) occur in such a pattern as to be described by a mathematical distribution. The pattern of rain, political climate, snow, labor strikes, etc., all combine to affect wheat prices. The Poisson distribution describes the probability of occurrence of these variables as a group.

The Poisson Process. The Poisson distribution is used for the computation of the conditional probabilities. The Poisson distribution best describes the process by which information concerning wheat prices is generated.

The two basic criteria which must be met by a Poisson process are those of stability and independence. In order to apply the Poisson distribution the spaces in which the "successes" occur must be divided into segments small enough to eliminate the possibility of two or more "successes" occurring in any one segment. If that condition is possible, the process may be treated as a Bernoulli process.

The conditions of stability and independence are assumed to be met due to the large number of farms and the large geographic distribution of these farms. It could be argued that weather conditions violate

TABLE 13

COMPUTATION OF POSTERIOR PROBABILITIES

State of Nature B_j	Rate of Return (Per Cent)	Prior Probabilities $P(B_j)$	Conditional Probabilities $P(A_i \mid B_j)$	Joint Probability $P(B_j)P(A_i \mid B_j)$	Posterior Probability
B_1	-200 or Less	.20	.0	.0	.0
B_2	-50 to -199	.20	.0000277	.05554	.0348
B_3	-49 to +49	.23	.04357	.0100211	.8658
B_4	+40 to +199	.23	.006733	.0015486	.1380
B_5	+200 and Greater	.14	.0000268	.0538	.0332
				.0115740	1.0000

the condition of independence, as rain in one segment of the defined space is more likely to be succeeded by rain in the next segment than by no rain. The condition of independence is valid due to wheat prices being affected by weather conditions throughout the world.[2]

Value of the Process Parameter. In actual fact, as with most business problems, the parameter of the process is unknown. If this value is unknown, then the Poisson distribution cannot be applied. An approximation can be used for assessing the value of the parameter if the approximation will not lead to a decision which is materially worse than using the exact parameter.[3]

The process parameter (k) used in this study is the expected number of price affecting variables per unit of space. The total units of space is defined as the number of trading days in a contract multiplied by the division of the trading day into fifteen minute intervals. The trading day is assumed to be six hours in length. Using 245 trading days and 24 fifteen minute intervals, the total amount of space is 5880 units. If the number of "successes" in 5880 time periods is 245, then $k = .04167$. The statistic 245 is the number of "successes" that are expected to occur if the variables affecting wheat prices are mostly negative (prices falling).

From Table 12 the distribution of annual rates of return may be assessed. The distribution in Table 12 is reduced to a more manageable level by dividing the rates of return into five large classes

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[2]Robert Schlaifer, Probability and Statistics for Business Decisions, McGraw-Hill Book Company, Inc., New York, 1959, pp. 214-16.

[3]Ibid., pp. 196-208.

as presented in Table 13. The numerical values 1 through 5 discussed in the section Development of the Data are associated with the classes of rates of return. The value associated with a -200 per cent rate of return or less is an average value of a 1 per trading day or 245 for a contract held from the first to the last trading date, for the bracket -50 per cent to -199 per cent an average value of a 2 for a k = .08333; for the bracket -49 per cent to +49 per cent an average value of a 3 for a k = .1250; for the bracket +50 to +199 per cent an average value of a 4 for a k = .1667; and, for the bracket +200 per cent and greater a value of 5 for a k = .20833.

"In general, the probability that a Poisson process generating k successes per unit of space will generate r successes in space t depends only on the produce m = kt; it is given by the formula

$$P_{Po}(r) = \frac{e^{-(kt)}\,(kt)^r}{r!} = \frac{e^{-m}\,m^r}{r!}$$

where e is a constant equal to 2.718 . . . ."[4]

If the values of the random variable r are small (r=50) and the units of space (t) are small (t=200), then, the A Programming Language for the IBM 360 computer may be used in direct computation of the probability of r successes. Most statistics texts have short tables or charts for finding $P_{Po}(r)$ and a text by E. C. Molina has extensive tables of the Poisson distribution.[5]

The values of r and t quickly change over time and for contracts held over a few weeks, the $P_{Po}(r)$ must be approximated. The

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[4]Ibid., p. 213.

[5]E. C. Molina, Poisson's Exponential Binomial Limit, D. Van Nostrand Company, Inc., Princeton, N.J., 1942.

Normal distribution is the limiting form of the Poisson as m approaches infinity.

Since the random variables in the commodity market are often too large numerically for direct usage of the Poisson computational formula for the probability of r successes in a Poisson process, $P_{Po}(r)$, the investor must use an approximation. The example given to illustrate the approximation is based on data for the crop year beginning July 1, 1968, and contains a sample for the month of July, 1968. The random variables of information concerning the weather, the political climate, demand/supply, and Department of Agriculture announcements are summarized from the Wall Street Journal according to the system shown under the section Development of the Data. The r for this period has a numerical value of 70 and the t a value of 528 since July, 1968, had 22 trading days.

The procedure for the approximation of $P_{Po}(r)$ is computed as follows:

$E(\tilde{r}) = m = kt$ where $\tilde{r}$ is the approximation of our random variable and $E(\tilde{r})$ is the expected value of the approximated random variable, and

$$\sigma(\tilde{r}) = m^{\frac{1}{2}}$$

If the state of nature is -200 per cent or less, the

$$E(\tilde{r}) = kt = .04167(528) = 22, \text{ and}$$

$$\sigma(\tilde{r}) = m^{\frac{1}{2}} = 4.69$$

In order to standardize our distribution for computational purposes

$$u = \frac{r - E(r)}{\sigma(\tilde{r})} = \frac{70 - 22}{4.69} = 10.23.$$

Searching the normal distribution tables for this value is unsuccessful and a value of 0 is assigned to the conditional probability of r = 70 if $E(\tilde{r})$ = 22.

For the rate of return -50 per cent to -199 per cent E(r) = 44

$$u = \frac{70 - 44}{6.63} = 3.92$$

the probability that a standardized random variable is greater than 3.92 standard deviations is .0001837. Converting to the original distribution, the area of the curve for r = 70 is

$$\frac{1}{\sigma(\tilde{r})} .0001837 = .000027$$

which is the conditional probability, $P(A_i | B_j)$, where A_i = 70 and B_j = 44.

The conditional probabilities for the other states of nature given in Table 13 are computed in the same manner with the parameter m and the standardized variable u (Table 14).

TABLE 14

m AND u FOR THE SAMPLE OF JULY, 1968

Rate of Return (Per Cent)	m	u
-200 or less	22	10.23
-50 to -199	44	2.92
-49 to +49	66	.4926
+50 to +199	88	1.919
+200 or greater	110	3.81

Investment Strategy. The posterior probability for State of Nature B_3 is now .8658 as opposed to the prior probability of .23 for a rate of return from -49 to +49 per cent. An alternative strategy to be followed could be the investment in a commodity other than wheat, or a long position in the options for the 1968-69 wheat crop. The latter position is warranted as the posterior probability distribution is weighted toward the positive states of nature with values of .1380 and .00032 for B_4 and B_5 respectively. The former position could be elected due to the high probability of B_3 since the hypothetical investor rejects possible returns of B_3 as not acceptable for the risks inherent in the futures market.

The investment strategies assumed by the investor are:

(1) Take a short position when the posterior probability is weighted toward B_1 or B_2.

(2) Reverse a long position when the posterior probability is weighted toward B_1 or B_2.

(3) Take a long position when the posterior probability is weighted toward B_4 or B_5.

(4) Reverse a short position when the posterior probability is weighted toward B_4 or B_5.

(5) Find an alternative investment if the posterior probability favors B_3 with a probability greater than the arbitrary value of .75.

Summary

Bayes Theorem is now being applied to many business decisions. Its use in the commodity futures market is nebulous due to the number of variables which affect the price of a commodity at a future date. The option prices of wheat are used in the calculation of rates of return for the hypothesized States of Nature (B_j). The B_j are divided into five mutually exclusive and collectively exhaustive classes. Certain events are associated with these classes of rates of return. The events include all factors that are assumed to be of major significance in determining the price of wheat. The four major classes of events sampled are: (1) the weather, (2) the political climate, (3) direct demand/supply affecting variables, and (4) announcements by the Department of Agriculture.

"The general form of Bayes' Theorem is

$$P(B_j|X_i) = \frac{P(B_j)\ P(X_i|B_j)}{P(B_j)\ P(X_i\ B_j)} \quad . \ . \ . \text{"}^6$$

$P(B_j|X_i)$ is the posterior probability of the states of nature confronting the investor after he has sampled the information available for making a decision.

The prior probabilities, $P(B_j)$, are established by <u>ex post</u> data and weighted by the conditional probabilities, $P(X_i|B_j)$ of the sample. The Poisson distribution best describes the manner in which the random variables (r) are generated. When the random variables are too large numerically to utilize the computational formula of the Poisson, the

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[6] Samuel B. Richmond, Statistical Analysis, 2nd ed., The Ronald Press Company, New York, 1964, p. 274.

probability of r is approximated by the normal distribution.

The investor runs a continuous search of the random variables and adjusts his position in the futures market according to the results generated by the posterior probabilities. The investor has elected to forego investment in the futures market whenever the posterior probability is .75 or greater for the state of nature B_3 (rate of return -49 to +49 per cent).

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Summary

Risk Analysis Applied to Commodity Speculation is an attempt to provide a pilot approach for investment decision-making. The method may be used for almost any type of investment. The commodity market has been chosen for several reasons: (1) if the procedure can be used in commodity futures speculation, it may be applied with greater validity to areas of investment whose states of nature and their likelihood of occurrence are more easily determinable; (2) the commodity futures area has not been the subject of research in the area of risk to the extent of research in the securities market; (3) trading data necessary for the study is available in suitable form; (4) volume of trading in the commodity grains is high enough to provide a competitive pricing situation.

The method applied is based on Bayes Theorem, which is of the form:

$$P(B_j | A_i) = P(B_j)P(A_i | B_j)/P(A_i)$$

where

$P(B_j)$ is the prior probability of a particular state of nature,

$P(A|B)$ is the conditional probability of event A given B,

$P(A_i)$ is the sum over all compound probabilities, $P(A_i, B_j)$.

The prior probabilities are based on an ex post frequency distribution of rates of return. The rates of return are computed from entering a futures contract on a randomly selected date at the close 1 price and holding the contract until the last trading day of the contract. The rate of return is the rate of profit (loss) based on an assumed investment of $500 (the normal margin requirement). The distribution of rates of return has fourteen classes ranging from a positive 1000 per cent or greater to a negative 1000 per cent or less. Such wide swings are possible because of the very narrow margin required for a wheat contract in contrast to its total market price.

The prior probabilities are based on daily price data for wheat futures for the crop years 1957-62 and the calendar years 1967-68 involving approximately 4,700 individual rates of return. The distribution is bimodal with the mean value of the rate of return distribution slightly less than 0. The peaks of each of the modes is in the rate of return class +100 to +200 and -100 to -200 per cent. This unusual distribution of returns is explained by the type of investment involved. The contract is a futures contract, and over the long run, the parties to the futures contracts as a group should receive rates of return with a mean value of 0 minus the cost of the transaction (brokerage fee). The two modes, which are both bell shaped and of equal standard deviations, substantiate that investors over-estimate and under-estimate the future price of wheat equally over a long period of time. The small values occurring near the 0 rate of return reflect the large price swings inherent in the wheat market and the difficulty in forecasting the states of nature and their effect on the commodity market.

The variables affecting the rates of return are fundamentally related to the price changes in wheat. A correlation analysis was performed on many fundamental variables such as: (1) weather conditions, (2) the political climate, (3) direct demand/supply affecting factors and (4) announcements by the U.S. Department of Agriculture concerning the expected production of wheat. These variables occur according to the conditions defining a Poisson distribution. The conditional probabilities are computed by the computational formula for the Poisson probability of a variable (r). When the variable (r) exceeds the size that can be handled by the A Programming Language for the IBM 360, the Poisson probability is approximated by the normal distribution.

The conditional probabilities are based on sampling information and combined with the prior probabilities in order to form a posterior probability distribution. Decisions on whether to change a current investment position or enter into a new contract are then based on the posterior distribution.

Risk and Random Selection Strategies

A random selection investment program (Strategy 1) was developed for three purposes: (1) as a yardstick for measuring the effectiveness of investment strategies in the wheat futures market, (2) as a basis for the prior probabilities of Bayes Theorem, and (3) to establish ex post the rates of return in the wheat futures market.

The wheat contracts are classified into twelve time classes according to the number of days the contract is held. The rates of return are calculated for each class and converted to an annual rate of return to facilitate comparison with other investment strategies.

The randomly selected contracts from Strategy 1 are adjusted by filter rules based on the risk assigned to specific contracts for specific calendar months of purchase. The filter rules produce the desired effect of limiting the downside risk of a particular position (short or long) and increasing the upside gain of a short or long position. A filter rule is developed for a short position (Strategy 3) and for a long position (Strategy 2).

The risk assigned to a particular position is based on ex post data. The price variation for each contract purchased in each month over the time periods 1957-62 and 1967-68 is summarized as the standard deviation of the difference between the high and low daily price by calendar month for each contract. The results of the study on risk disclose a significantly larger risk (greater standard deviation) for a position taken in the delivery month of the contract than for all other months of the contract. A greater risk is also exhibited for all wheat contracts entered in June, July, and August than for any of the other calendar months. The brokerage houses, nonetheless, have a $500 margin requirement for all contracts without regard to the calendar month in which a position is taken by an investor.

The price data was drawn from two time periods which straddle two important United States laws. The Agriculture Act of 1964 significantly changed the support prices and wheat allotments from previous acts. The General Agreement on Tariffs and Trade of 1967 affected international trading in the grains.

Conclusions

1. Bayes Theorem can be applied to the wheat futures market to provide a quantitative answer to a highly subjective area. The study provides the empirical data necessary for computing prior and conditional probabilities.

2. The expected rate of return over the long run from speculating in the futures market is approximately zero. This conclusion is supported by an empirically determined rate of return of -5 per cent from a random investment program covering 4700 randomly selected option purchases. The loss ratio is the average brokerage expense associated with a long and short futures contract (round-trip).

3. The rates of return on the wheat futures market have an extremely wide range. A random selection program involving simulated positions in each of four option contracts from 1957 through 1962 (4700 iterations) yielded rates of return in excess of -1,000 per cent or less approximately 4 per cent of the time and +500 per cent or more for 5 per cent of the time. The distribution is bimodal with the peak of each mode falling into its respective rate of return class of -100 to -200 per cent and +100 to +200 per cent.

4. It was found that a wheat option has greater price variation during June, July, and August than in other months.

5. Filter rules based on <u>ex post</u> data of price variation

limited an investor's downside risk and increased his profit potential when compared to a random buy-hold policy. The filter rules worked equally well for short or long positions.

6. A correlation of daily price changes with news items concerning the demand and supply of wheat produced low statistical correlations. Values for r were greater than -.20 and less than +.20. It was, therefore, concluded that acting on news releases relative to supply/demand was ineffective in improving trading profits.

7. The flat $500 margin required by brokerage houses on a wheat contract should be revised to reflect the price variation for the particular calendar purchase month and the particular option purchased. Otherwise, the amount bears little relationship to contract price changes and the maintainance of margin requirement.

Areas for Further Research

Each of the sub-areas explored in this paper could be examined in greater depth. Several suggestions for improving the reliability of the forecast are now presented.

The filter-rule is used only on the initial purchase of a contract in the study, and it could be applied on a daily basis to limit risk. The filter could be based on data other than the price variation of the same contract in the preceding year. A quadratic program could be developed for estimating the standard deviation that should be used in the filter.

An examination of the level of significance of the differences between investment returns in June, July, and August for all contracts and those for other calendar months would be a major contribution. Additionally, developing specific strategies with hedges and straddles would expand the alternatives available to the investor.

In order for the present study to be practically applied, the data base must be expanded. The data bank should include all prices for all commodities and also a data bank of the States of Nature and their relation to specific price changes. Further refinement of the data could be attained by a separation of variables effecting near term as opposed to distant contracts.

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APPENDICES

APPENDIX A

COMPUTER PROGRAMS

This appendix contains the five computer programs developed specifically for this study. Each program is explained more completely within the text.

Program A-1 is used to convert the IBM punched card to magnetic tape.

Program A-2 calculates the arithmetic mean, standard deviation, standard error, t value, and the range of the difference between the daily high and low prices for each contract and each calendar month of the study.

Program A-3 combines the magnetic tapes. The punched card data for 1955-62 is stored on one tape and the punched card data for 1967-68 is stored on a second tape.

Program A-4 calculates the profit from two strategies. Strategy 1 is the profit (loss) from a contract position entered into on the fifth trading date of the contract and sold five days before trading is terminated. Strategy 2 is the profit (loss) from entering a contract five days before trading in a contract terminates and selling the contract at the close 1 price of the last trading day.

Program A-5 has three distinct outputs: 1) the rate of return and standard deviation for each of 12 time divisions for each contract, 2) the mean rate of return over all years for each of the contracts, and 3) a frequency distribution and a percentage distribution of 1) and 2) above divided into 14 classes of rates of return.

The rates of return in 1) and 2) are based on dates randomly selected. A filter rule based on Program A-2 is incorporated into the random strategy.

Program A-6 performs a simple correlation of daily wheat prices with the critical variables assumed in the study (see Table 11 in the text for the correlation coefficients). The values for the critical variables are established by the analyst (the author) from news items appearing in the Wall Street Journal.

Punched Card Format

Column	Content
1- 2	Calendar month
3- 4	Day
5- 6	Year
1- 6	Date particular prices occurred for each wheat contract
7- 9	High price of the day for a specific contract
10	Eighths of a point, converted to a decimal in Program A-1
11-13	Low Price for the day's trading
14	Eighth of a point
15-17	Close 1 price
18	Eighths
19-21	Close 2 price
22	Eighths
23	Blank
24-46	Repeat the above sequence

47-69	Repeat the sequence of columns 1-23
70-71	Code for wheat represented by an 01
72-73	Option month
74-75	Option year

PROGRAM A-1

```
      DIMENSION Z(350,4), X(27), K(350)
      DO 5100 L=1,100
      I=0
      READ(1,50) X,IE
      GO TO 20
   10 READ(1,50) X,IV
   50 FORMAT(3(F6.0,F3.2,F1.0,F3.2,F1.0,F3.2,F1.0,F3.2,F1.0,1X),I6)
   20 DO 2000 J=1,19,9
      IF(X(J)-0.) 75,65,75
   65 IF(J-1) 10,4000,10
   75 I=I+1
      Z(I,1)=X(J+1)+.00125*X(J+2)
      Z(I,2)=X(J+3)+.00125*X(J+4)
      Z(I,3)=X(J+5)+.00125*X(J+6)
      Z(I,4)=X(J+7)+.00125*X(J+8)
 2000 K(I)=X(J)
      GO TO 10
 4000 WRITE(3,300) I,IE
  300 FORMAT(2I6,6X)
      WRITE(8,300) I,IE
      DO 5100 M=1,I
 5100 WRITE(8,5) (Z(M,MM),MM=1,4),K(M)
    5 FORMAT(4F9.5,I6)
      END
```

PROGRAM A-2

```
      DIMENSION XBAR(24),STD(24),SE(24),R(24),T(24),TN(24),TNN(24)
     1 ,SMIS(5,12)
      T20=2.528
      REWIND 8
      READ(1,90) T
   90 FORMAT(16F5.3)
      READ(1,97) ((SMIS(I,J),I=1,5),J=1,12)
   97 FORMAT(12F5.2)
    1 WRITE(3,94)
   95 FORMAT('1',10X,'JANUARY    FEBRUARY    MARCH    APRIL    MAY
     1  JUNE        JULY       AUGUST    SEPTEMBER  OCTOBER   NOVEMBER    DECE
     2MBER')
      DO 10 L=1,5
      NN=1
      READ(8,96) IX,IEX,IEXP
   96 FORMAT(I6,2X,2I2,6X)
      READ(8.91) XH,XL,XC1,XC2,IDAT
   91 FORMAT(4F9.5,I2,4X)
      DO 92 I=1,24
      XBAR(I)=0.
      STD(I) =0.
      TNN(I) =0.
      SE(I)  =0.
      TN(I)  =0.
   92 R(I)   =0.
      J =  IDAT
```

```
      IC=IEX
      IE= IEXP
    2 ID=IDAT
      SUMD=0.
      SUMD2=0.
      XHH-0.
      XLL=999.
      DO 20 N=1,24
      X=XH-XL
      SUMD=SUMD+X
      SUMD2=SUMD2+X*X
      IF(XH.GT.XHH) XHH=XH
      IF(XL.LT.XLL) SLL=XL
      IF(NN.EQ.IX) GO TO 30
      READ(8,91) XH,XL,XC1,XC2,IDAT
      NN=NN+1
      IF(ID.NE.IDAT) GO TO 30
   20 CONTINUE
      STOP
   30 XN=N
      XBAR(J)=SUMD/XN
      STD(J)=SQRT((XN*SUMD2-SUMD*SUMD)/(XN*(XN-1.)))
      SE(J)=STD(J)/SQRT(XN)
      TN(J)=STD(J)*T(N)
      TNN(J)=T(N)
      R(J)=XHH-XLL
```

PROGRAM A-2 (CONTINUED)

```
      J=J+1
      IF(NN.LT.IX) GO TO 2
      DO 40 I=1,5
      IF(IC.EQ.2*I+1) GO TO 45
   40 CONTINUE
   45 II=I
      DO 50 J=1,24
      JJ=J
      IF(J.GT.12) JJ=J-12
      IF(STD(J)) 55,55,50
   55 STD(J)=SMIS(II,JJ)
      TNN(J)=T20
      TN(J)=STD(J)*TNN(J)
   50 CONTINUE
      WRITE(9,6) TNN,STD
    6 FORMAT(24F8.4/24F8.4)
      WRITE(3,94) IC,IE
   94 FORMAT('0',I3,'/',I2)
      WRITE(3,93)(XBAR(K),K=1,12),(STD(K),K=1,12),(SE(K),K=1,12),
     1(TN(K),K=1,12),(R(K),K=1,12)
   93 FORMAT(' ',8X,12F10.4,'= X'/9X,12F10.4,'= S'/9X,12F10.4,'= SE'/
     19X,12F10.4,'=T*S'/9X,12F10.4,'=R')
      WRITE(3,93)(XBAR(K),K=13,24),(STD(K),K=13,24),(SE(K),K=13,24),
     1(TN(K),K=13,24),(R(K),K=13,24)
   10 CONTINUE
      GO TO 1
      END
```

PROGRAM A-3

```
C         COMBINE TAPES 180,181, = 182
      DIMENSION TN(24),S(24),Z(4)
      DO 1 LL=1,100
      READ(8,90)  I,J
   90 FORMAT(2I6,6X)
      WRITE(10,90) I,J
      DO 20 M=1,I
      READ(8,91) Z,L
   91 FORMAT(4F9.5,I6)
   20 WRITE(10,91) Z,L
      READ(9,95) TN,S
   95 FORMAT(24F8.4/24F8.4)
    1 WRITE(10,95) TN ,S
      STOP
      END
```

PROGRAM A-4

```
      DIMENSION K(350),Z(350,4),T(48),SX(2),XM(2),KT(40)
      READ(1,92) KT
   92 FORMAT(40I2)
      DO 1 ICC=1,40
      DO 5 M=1,2
    5 SX(M)=0.
      XN=KT(ICC)
      ID=KT(ICC)
      DO 10 ID1=1,ID
      READ(10,2) I,IE
    2 FORMAT(2I6,6X )
      DO 20J=1,I
   20 READ(10,6) (Z(J,JJ),JJ=1,4),K(J)
    6 FORMAT(4F9.5,I6)
      READ(10,4) T
    4 FORMAT(24F8.4/24F8.4)
      P=(Z(I-5,3)*5000.-22.)-Z(5,3)*5000.
      A=I
      R=A*P/((A-10.)*500.)
      PP=(Z(I,3)*5000.-22.)-Z(I-5,3)*5000.
      RR=A*PP/2500.
      SX(1)=SX(1)+R
      SX(2)=SX(2)+RR
   10 WRITE(3,90) IE,P,R,IE,PP,RR
```

PROGRAM A-4 (CONTINUED)

```
90 FORMAT('OSTRATEGY 1:  EXP DATE =',I5,'  PROFIT =',F12.2,' % RATE
  1 OF RETURN =',F12.2/' STRATEGY 2:  EXP DATE =',I5,'  PROFIT =',
  2F 12.2,'    % RATE OF RETURN =',F12.2)
40 DO 50 L=1,2
50 XM(L)=SX(L)/XN
   N=IE/100
 1 WRITE(3,91) N,XN,XM(1),XM(2)
91 FORMAT('0',I4,'CONTRACT FOR',F3.0,' YEARS'/' STRATEGY 1:  MEAN RAT
  1E OF RETURN =',F15.3,/' STRATEGY 2:  MEAN RATE OF RETURN =',F15.3)
   END
```

PROGRAM A-5

```
C      THIS PROGRAM RANDOMLY DETERMINES BUYING & SELLING DATES FOR A
       COMMODITY.  (OUTPUT)  STRATEGIES:  BUY ON A RANDOMLY DETERMINED
       DAY AND:  (1)  SELL ON THE CLOSING DAY OF THE CONTRACT.  (2)
       (LONG) SELL WHEN FILTER DROPS BELOW THE LOW FOR A PARTICULAR DAY.
       (3) (SHORT) SELL WHEN FILTER BECOMES GREATER THAN THE HIGH FOR A
       PARTICULAR DAY.  IF (2) & (3) DO NOT OCCUR IN A CONTRACT YEAR
       THAN THEY ARE THE SAME AS (1).
      DIMENSION K(350),Z(350,4),T(24),S(24),SX(3,12),SSX(3,12),SN(3,12),
     1 ST(3,12),KT(40),INT(12),RATE(13),FREQ(12,14,6)
      DO 11 L=1,12
      DO 11 I=1,14
      DO 11 J=1,6
   11 FREQ (L,I,J)=9.
      REWIND 10
      READ(1,2) INT
    2 FORMAT(12I4)
      READ(1,3) RATE
    3 FORMAT(13F6.2)
C       STARTING VALUE FOR THE RANDOM NUMBER GENERATOR.
      IX=312933
C       READ HOW MANY YEARS PROCESSED UNDER EACH CONTRACT (INPUT ON
        A CARD).
      READ(1,92) KT
   92 FORMAT(40I2)
      DO 4 KTT=1,40
      IF(KT(KTT+1).EQ.0)  GO TO 1
```

PROGRAM A-5 (CONTINUED)

```
    4 CONTINUE
    1 DO 99 ICC=1,KTT
    5 DO 10 JO=1,3
      DO 10 J1=1,12                                                     01
   10 ST(JO,J1)=0.                                                      01
      XN=KT(ICC)
      ID=KT(ICC)
C      READ HOW MANY DAYS ARE IN THE CONTRACT & EXPIRATION DATE.
   15 READ(10,80) I,IE
   80 FORMAT(2I6,6X)
C      READ HIGH, LOW, CLOSE ONE, CLOSE TWO, FOR EACH DAY (K),
      DO 20 J=1,I                                                       01
   20 READ(10,81) (Z(J,JJ),JJ=1,4),K(J)
   81 FORMAT(4F9.5,I6)
      DO 90 ID1=1,ID
   25 DO 30 J2=1,3
      DO 30 J3=1,12                                                     01
      SX(J2,J3)=0.                                                      01
      SSX(J2,J3)=0.                                                     01
   30 SN(J2,J3)=0.                                                      01
C      READ CONFIDENCE VALUE AND STD DEV FOR THE MONTH OF THE PREVIOUS
       YEAR.
   32 READ(10,82) T,S
   82 FORMAT(24F8.4/24F8.4)
   35 READ(10,80) I,IE
      DO 40 J=1,I                                                       01
```

PROGRAM A-5 (CONTINUED)

```
  40 READ(10,81) (Z(J,JJ),JJ=1,4),K(J)
C      NUMBER OF DAYS IN THE CONTRACT.
     BB=I                                                              02
C      RANDOM NUMBER GENERATOR (RANDU).
                 DO 50 KK=1,240
     DO 72 JT=1,12
     IF(ILE.LE.INT(JT)) GO TO 73
  72 CONTINUE
  73 IC=JT
C      PROFIT & RATE ON STRATEGY 2.
     P=(U*5000.-22)-Z(IB,3)*5000.
     R=BB*P/((XLL-E)*500.)
  75 SN(2,IC)=SN(2,IC)+1.
     SX(2,IC)=SX(2,IC)+R
     SSX(2,IC)=SSX(2,IC)+R*R
C
C      STRATEGY 3
     DO 76 LL=IG,I
     IF(V.LT.Z(LL,1)) GO TO 77
  76 CONTINUE
     P=-PP
     IC=ICD
     GO TO 78
  77 XLL=LL
  ILE=XLL-E
  DO 83 JT=1,12
```

PROGRAM A-5 (CONTINUED)

```
      IF(ILE.LE.INT(JT)) GO TO 84
   83 CONTINUE
   84 IC=JT
      P=Z(IB,3)*5000.-(V*5000.+22.)
   78 R=BB*P/((XLL-E)*500.)
      SN(3,IC)=SN(3,IC)+1.
      SX(3,IC)=SX(3,IC)+R
      SSX(3,IC)=SSX(3,IC)+R*R
   50 CONTINUE
      WRITE(3,111)
  111 FORMAT('1',////////)
      DO 90 MM=1,3
      WRITE(3,97)
   97 FORMAT('0')
      DO 90  M=1,12
      IF( SN(MM,M)-1.) 86,86,88
   86 XM=0.
      SD=0.
      GO TO 85
C       MEAN % RATE OF RETURN & STANDARD DEVIATION.
   88 XM=SX(MM,M)/SN(MM,M)
      D=SN(MM,M)*SSX(MM,M)-(SX(MM,M)*SX(MM,M))
      IF(D.LE.0.) D=.00001
   89 SD=SQRT(D/(SN(MM,M)*(SN(MM,M)-1.)))
        WRITE STRATEGY, MEAN,STD DEV.& EXPIRATION DATE FOR 12 PARTITIONS.
   85 WRITE(3,87) MM,XM,SD,IE
```

PROGRAM A-5 (CONTINUED)

```
   87 FORMAT(' STRATEGY',I2,' MEAN =',F12.3,'    STD DEV =',F12.3,I9,
     1  4F15.4)
   90 ST(MM,M)=ST(MM,M)+XM
      WRITE(3,111)
      LX=IE/100-100
  105 DO 120 N=1,3
      WRITE(3,97)
   42 IY=IX*65539
      IF(IY.GT.0) GO TO 6
      IY=IY+2147483647
    6 YFL=IY
      RANDU=YFL*.4656613E-9
      IX=IY
      IB=BB*RANDU+.5
      IF(IB.LE.0)  IB=1
      E=IB
C
C      STRATEGY 1:  P=PROFIT,  R=% RATE OF RETURN.
      P=(Z(I,3)*5000.-22)-Z(IB,3)*5000.
      PP=P
      IF(BB.EQ.E) GO TO 42
      R=BB*P/((BB-E)*500.)
C      DIVIDE CONTRACT INTO 12 PARTITIONS.
      IBE=BB-E
      DO 43 JT=1,12
      IF(IBE.LE.INT(JT)) GO TO 44
```

PROGRAM A-5 (CONTINUED)

```
   43 CONTINUE
   44 IC=JT
      ICD=IC
      DO 500 M=1,13
      IF(R.LE.RATE(M)) GO TO 501
  500 CONTINUE
      M=14
  501 FREQ(IC,M,ICC)=FREQ(IC,M,ICC)+1.
      FREQ(IC,M,6)=FREQ(IC,M,6) +1.
C      SAVE # OBSERVATIONS, SUM OF R & SUM SQUARE OF R.
      SN(1,IC)=SN(1,IC)+1.
      SX(1,IC)=SX(1,IC)+R
   45 SSX(1,IC)=SSX(1,IC)+R*R
      L=K(IB)/10000
C      TEST ERROR CONDITIONS.
      IF(L) 46,46,49
   49 IF(L-24) 47,47,46
   46 WRITE(3,1111) L,K(IB),IB
 1111 FORMAT(4I10)
      GO TO 50
   47 IF(T(L).LE.0.) L=L+12
      IF(T(L).LE.0.) WRITE(3,98) T(L)
   98             FORMAT(F20.4)
C      FILTERS:  U=STRATEGY 2,     V=STRATEGY 3.
   48 U=Z(IB,3)-T(L)*S(L)
      V=Z(IB,3)+T(L)*S(L)
```

PROGRAM A-5 (CONTINUED)

```
C
C     STRATEGY 2
      IG=IB+1
      DO 60 LL=IG,I
      IF(U.GT.Z(LL,2)) GO TO 70
   60 CONTINUE
      GO TO 75
   70 XLL=LL
      ILE=XLL-E
      DO 120NN=1,12
      XM=ST(N,NN)/XN
C     WRITE MEAN FOR THE NO. OF YEARS ONE OF THE 5 CONTRACT MO. IS
      PROCESSED.
  120 WRITE(3,110) N,XM,LX
  110 FORMAT(' STRATEGY',I2,'   MEAN RATE OF RETURN =',F12.3,I10)
      READ(10,82) T,S
   99 CONTINUE
      DO 505 I=1,6
      WRITE(3,510) RATE
  510 FORMAT('1',4X,13F8.1///)
      WRITE(3,506)
  506 FORMAT('0',44X,'FREQUENCY DISTRIBUTION'///)
      WRITE(3,515) ((FREQ(L,J,I),J=1,14),L=1,12)
  515 FORMAT(' ',14F8.1)
      DO 525 L=1,12
      W=0.
```

PROGRAM A-5 (CONTINUED)

```
    DO 520 J=1,14
520 W=W+FREQ(L,J,I)
    IF(W.EQ.0.) GO TO 526
    DO 525 J=1,14
525 FREQ(L,J,I)=FREQ(L,J,I)/W*100.
526 WRITE(3,507)
507 FORMAT('0',42X,'% FREQUENCY DISTRIBUTION'///)
505 WRITE(3,515) ((FREQ(L,J,I),J=1,14),L=1,12)
    DO 530 L=1,12
    DO 530 J=2,14
530 FREQ(L,J,6)=FREQ(L,J-1,6)+FREQ(L,J,6)
    WRITE(3,510) RATE
    WRITE(3,535)
535 FORMAT('0',42X,'% CUMULATIVE DISTRIBUTION'///)
    WRITE(3,515) ((FREQ(L,J,6),J=1,14),L=1,12)
    STOP
    END
```

PROGRAM A-6

```
      DIMENSION D(360,5),C(360,8),X(27),E(360,2),F(360),G(360,5)
      DATA D,C,E,F/1800*0.,2880*0.,720*0.,360*0./,G/1800*0./
      H=0.
      DO 2 K=1,360,5
      L=K+4
      READ(1,90) ((G(I,J),J=1,5),I=K,L)
   90 FORMAT(5(F6.0,4F2.0,2X))
      DO 2 M=K,L
      IF(G(M,1).EQ.0.) GO TO 5
      IA=G(M,1)
    2 G(M,1)=(IA-IA/100*100)*10000+IA/100
    5 I=M-1
      WRITE(3,9) I
    9 FORMAT(I10)
      DO 100 NA=1,3
      M=0
      READ(1,91) X
   91 FORMAT(3(F6.0,F3.2,F1.0,F3.2,F1.0,F3.2,F1.0,F3.2,F1.0,1X),I6)
      DO 12 K=1,19,9
      IF(X(K).LT.070158) GO TO 12
      M=M+1
      IA=X(K)
      E(M,1)=(IA-IA/100*100)*10000+IA/100
      E(M,2)=X(K+5)+.00125*X(K+6)
   12 CONTINUE
      DO 16 KK=1,120
```

PROGRAM A-6 (CONTINUED)

```
13 READ(1,91) X
   DO 16 K=1,19,9
   IF(X(K).EQ.0.) GO TO 13
   M=M+1
   IA=X(K)
   E(M,1)=(IA-IA/100*100)*10000+IA/100
   E(M,2)=X(K+5)+X(K+6)*.00125
15 IF(X(K)-063059) 16,20,16
16 CONTINUE
20 LL=0
   L=1
   DO 50 K=1,I
42 IF(G(K,1)-E(L,1)) 40,46,44
44 L=L+1
   GO TO 42
46 LL=LL+1
   D(LL,1)=G(K,1)
   D(LL,2)=G(K,2)
   D(LL,3)=G(K,3)
   D(LL,4)=G(K,4)
   D(LL,5)=G(K,5)
   F(LL)=E(L,2)
   L=L+1
50 CONTINUE
   WRITE(3,9) M,LL
```

PROGRAM A-6 (CONTINUED)

```
      I=LL
      DO 6 J=1,I
      C(J,1)=D(J,2)+D(J,3)+D(J,4)+D(J,5)
      C(J,2)=D(J,2)
      C(J,3)=D(J,3)
      C(J,4)=D(J,2)+D(J,3)
    6 C(J,5)=D(J,4)+D(J,5)
      C(1,6)=C(1,1)
      C(1,7)=C(1,4)
      C(1,8)=C(1,5)
      DO 7 J=2,I
      C(J,6)=C(J-1,6)+C(J,1)
      C(J,7)=C(J-1,7)+C(J,4)
    7 C(J,8)=C(J-1,8)+C(J,5)
      DO 35 K=1,8
      DO 30 J=1,2
      IF (K.EQ.1.AND.J.EQ.2) GO TO 35
      SX=0.
      SY=0.
      SSX=0.
      SSY=0.
      SXY=0.
      N=9
      DO 25 L=2,I
      M=L
      IF(J.EQ.2) M=M-1
```

PROGRAM A-6 (CONTINUED)

```
      IF(K.LT.6)  GO TO 22
   21 N=N+1
      NN=N
      IF(J.EQ.2) NN=N+1
      F(M)=E(NN,2)
   22 SX=SX+C(L,K)*C(L,K)
      IF(K-1) 24,23,24
   23 H=H+F(M)-F(M-1)
      SY=SY+H
      SSY=SSY+H*H
      SXY=SXY+C(L,K)*H
      GO TO 25
   24 SY=SY+F(M)
      SSY=SSY+F(M)*F(M)
      SXY=SXY+F(M)*C(L,K)
      IF(K.LT.6) GO TO 25
      IF(E(NN,1).LT.D(L,1)) GO TO 21
   25 CONTINUE
      XN=I-1
      IF(K.GE.6) XN=N
      R=0.
      EE=XN*SSY-SY*SY
      DD=XN*SSX-SX*SX
      IF(DD.LE.0..OR.EE.LE.0.)WRITE(3,99)SX,SSX,DD,XN,SY,SSY,EE
   (( FORMAT(4F12.2)
      IF(DD.LE.0..OR.EE.LE.0.) GO TO 30
```

PROGRAM A-6 (CONTINUED)

```
      STDX=SQRT(DD)/XN
      STDY=SQRT(EE)/XN
      R=(XN*SXY-SX*SY)/(STDX*STDY*XN*XN)
   30 WRITE(3,92) K,J,R
   92 FORMAT(215,'   R =',F10.4)
   35 CONTINUE
  100 CONTINUE
      STOP
      END
```

APPENDIX B

RANDOM SELECTION STRATEGIES

Three strategies are presented in table form. Strategy 1 is a random selection strategy. Strategy 2 is based on the same randomly selected dates as Strategy 1, but Strategy 2 employs a filter rule defined for a long position. Strategy 3 is identical to Strategy 2, but the filter rule is defined for a short position.

The three strategies are for the contracts July, 1956 through May 1962, excluding the December options (Table 1-B) and for all wheat contracts traded in the calendar years 1967-68 (Table 2-B). The last column of the tables in this appendix is the option code. The integer in column 1 represents wheat, the integers in the 2nd and 3rd columns are the option month and the last two columns are the option year. A summary of the mean rates of return for each contract may be found in Table 12 of the text.

The mean rate of return for each option and for each of the three strategies is presented in Table 3-B.

TABLE 1-B

RANDOM SELECTION STRATEGIES JULY, 1956, TO SEPTEMBER, 1962, OPTIONS

STRATEGY	1	MEAN =	-43.876	STD DEV =	21.682	10357
STRATEGY	1	MEAN =	-23.541	STD DEV =	9.558	10357
STRATEGY	1	MEAN =	-11.488	STD DEV =	1.688	10357
STRATEGY	1	MEAN =	-9.120	STD DEV =	0.966	10357
STRATEGY	1	MEAN =	-6.512	STD DEV =	0.532	10357
STRATEGY	1	MEAN =	-4.915	STD DEV =	0.892	10357
STRATEGY	1	MEAN =	-2.425	STD DEV =	0.375	10357
STRATEGY	1	MEAN =	-0.897	STD DEV =	0.461	10357
STRATEGY	1	MEAN =	0.533	STD DEV =	0.611	10357
STRATEGY	1	MEAN =	0.911	STD DEV =	0.302	10357
STRATEGY	1	MEAN =	0.606	STD DEV =	0.451	10357
STRATEGY	1	MEAN =	0.131	STD DEV =	0.162	10357
STRATEGY	2	MEAN =	-28.642	STD DEV =	14.558	10357
STRATEGY	2	MEAN =	-4.618	STD DEV =	1.585	10357
STRATEGY	2	MEAN =	-1.403	STD DEV =	0.314	10357
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	2	MEAN =	-0.639	STD DEV =	0.046	10357
STRATEGY	2	MEAN =	-0.923	STD DEV =	0.213	10357
STRATEGY	2	MEAN =	-0.736	STD DEV =	0.011	10357
STRATEGY	2	MEAN =	-0.289	STD DEV =	0.007	10357
STRATEGY	2	MEAN =	0.881	STD DEV =	0.462	10357
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	3	MEAN =	-16.629	STD DEV =	55.568	10357
STRATEGY	3	MEAN =	10.649	STD DEV =	49.818	10357
STRATEGY	3	MEAN =	404.554	STD DEV =	169.682	10357
STRATEGY	3	MEAN =	-0.889	STD DEV =	0.091	10357
STRATEGY	3	MEAN =	287.561	STD DEV =	333.111	10357
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10357
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10357

STRATEGY 1	MEAN =	-30.346	STD DEV =	9.481	10358
STRATEGY 1	MEAN =	0.189	STD DEV =	3.571	10358
STRATEGY 1	MEAN =	2.957	STD DEV =	1.263	10358
STRATEGY 1	MEAN =	0.234	STD DEV =	0.463	10358
STRATEGY 1	MEAN =	-0.805	STD DEV =	0.416	10358
STRATEGY 1	MEAN =	-0.688	STD DEV =	0.401	10358
STRATEGY 1	MEAN =	-0.473	STD DEV =	0.548	10358
STRATEGY 1	MEAN =	-0.812	STD DEV =	0.239	10358
STRATEGY 1	MEAN =	-0.102	STD DEV =	0.151	10358
STRATEGY 1	MEAN =	0.919	STD DEV =	0.304	10358
STRATEGY 1	MEAN =	0.360	STD DEV =	0.140	10358
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 2	MEAN =	-24.359	STD DEV =	12.414	10358
STRATEGY 2	MEAN =	-3.987	STD DEV =	3.321	10358
STRATEGY 2	MEAN =	-0.357	STD DEV =	2.398	10358
STRATEGY 2	MEAN =	-0.848	STD DEV =	0.201	10358
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 2	MEAN =	-0.559	STD DEV =	0.039	10358
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 2	MEAN =	1.042	STD DEV =	0.120	10358
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 3	MEAN =	-24.227	STD DEV =	16.863	10358
STRATEGY 3	MEAN =	-5.159	STD DEV =	2.657	10358
STRATEGY 3	MEAN =	-1.426	STD DEV =	0.383	10358
STRATEGY 3	MEAN =	-1.114	STD DEV =	0.060	10358
STRATEGY 3	MEAN =	11.797	STD DEV =	35.858	10358
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 3	MEAN =	84.150	STD DEV =	56.432	10358
STRATEGY 3	MEAN =	84.289	STD DEV =	41.442	10358
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10358
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10358

STRATEGY	1	MEAN =	-13.824	STD DEV =	12.784	10359
STRATEGY	1	MEAN =	6.807	STD DEV =	3.843	10359
STRATEGY	1	MEAN =	6.746	STD DEV =	0.594	10359
STRATEGY	1	MEAN =	5.004	STD DEV =	0.442	10359
STRATEGY	1	MEAN =	2.699	STD DEV =	0.741	10359
STRATEGY	1	MEAN =	2.167	STD DEV =	0.305	10359
STRATEGY	1	MEAN =	1.928	STD DEV =	0.189	10359
STRATEGY	1	MEAN =	1.928	STD DEV =	0.159	10359
STRATEGY	1	MEAN =	1.513	STD DEV =	0.345	10359
STRATEGY	1	MEAN =	1.382	STD DEV =	0.205	10359
STRATEGY	1	MEAN =	0.947	STD DEV =	0.230	10359
STRATEGY	1	MEAN =	0.725	STD DEV =	0.072	10359

STRATEGY	2	MEAN =	-21.587	STD DEV =	13.536	10359
STRATEGY	2	MEAN =	-2.463	STD DEV =	4.914	10359
STRATEGY	2	MEAN =	3.729	STD DEV =	4.158	10359
STRATEGY	2	MEAN =	3.788	STD DEV =	2.860	10359
STRATEGY	2	MEAN =	-0.563	STD DEV =	0.034	10359
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10359
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10359
STRATEGY	2	MEAN =	2.259	STD DEV =	0.101	10359
STRATEGY	2	MEAN =	1.773	STD DEV =	0.100	10359
STRATEGY	2	MEAN =	1.595	STD DEV =	0.067	10359
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10359
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10359

STRATEGY	3	MEAN =	-23.028	STD DEV =	12.535	10359
STRATEGY	3	MEAN =	-4.416	STD DEV =	1.857	10359
STRATEGY	3	MEAN =	-1.601	STD DEV =	0.500	10359
STRATEGY	3	MEAN =	-0.623	STD DEV =	0.225	10359
STRATEGY	3	MEAN =	-0.432	STD DEV =	0.002	10359
STRATEGY	3	MEAN =	-0.517	STD DEV =	0.016	10359
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10359
STRATEGY	3	MEAN =	-0.365	STD DEV =	0.002	10359
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10359
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10359
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10359
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10359

STRATEGY	1	MEAN =	23.839	STD DEV =	11.619	10360
STRATEGY	1	MEAN =	11.625	STD DEV =	3.321	10360
STRATEGY	1	MEAN =	3.307	STD DEV =	1.769	10360
STRATEGY	1	MEAN =	1.055	STD DEV =	0.464	10360
STRATEGY	1	MEAN =	0.982	STD DEV =	0.403	10360
STRATEGY	1	MEAN =	0.260	STD DEV =	0.222	10360
STRATEGY	1	MEAN =	0.980	STD DEV =	0.175	10360
STRATEGY	1	MEAN =	0.965	STD DEV =	0.156	10360
STRATEGY	1	MEAN =	1.075	STD DEV =	0.124	10360
STRATEGY	1	MEAN =	0.966	STD DEV =	0.190	10360
STRATEGY	1	MEAN =	0.920	STD DEV =	0.136	10360
STRATEGY	1	MEAN =	0.652	STD DEV =	0.103	10360
STRATEGY	2	MEAN =	-16.067	STD DEV =	13.372	10360
STRATEGY	2	MEAN =	-1.223	STD DEV =	6.750	10360
STRATEGY	2	MEAN =	-1.114	STD DEV =	0.225	10360
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10360
STRATEGY	2	MEAN =	-0.465	STD DEV =	0.017	10360
STRATEGY	2	MEAN =	-0.447	STD DEV =	0.004	10360
STRATEGY	2	MEAN =	-0.334	STD DEV =	0.031	10360
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10360
STRATEGY	2	MEAN =	1.113	STD DEV =	0.085	10360
STRATEGY	2	MEAN =	1.158	STD DEV =	0.081	10360
STRATEGY	2	MEAN =	1.161	STD DEV =	0.046	10360
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10360
STRATEGY	3	MEAN =	-19.831	STD DEV =	10.783	10360
STRATEGY	3	MEAN =	-4.169	STD DEV =	1.760	10360
STRATEGY	3	MEAN =	-1.422	STD DEV =	0.284	10360
STRATEGY	3	MEAN =	-0.820	STD DEV =	0.102	10360
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10360
STRATEGY	3	MEAN =	0.384	STD DEV =	2.740	10360
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10360
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10360
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STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10360
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10360
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10360

STRATEGY 1 MEAN =
4.837 STD DEV =
STRATEGY 1 MEAN =
1.156 STD DEV =
STRATEGY 1 MEAN =
6.490 STD DEV =
STRATEGY 1 MEAN =
2.224 STD DEV =
STRATEGY 1 MEAN =
0.528 STD DEV =
STRATEGY 1 MEAN =
0.068 STD DEV =
STRATEGY 1 MEAN =
0.932 STD DEV =
STRATEGY 1 MEAN =
1.054 STD DEV =
STRATEGY 1 MEAN =
1.116 STD DEV =
STRATEGY 1 MEAN =
0.836 STD DEV =
STRATEGY 1 MEAN =
0.835 STD DEV =
STRATEGY 1 MEAN =
0.854 STD DEV =

STRATEGY 2 MEAN =
1.008 STD DEV =
STRATEGY 2 MEAN =
3.460 STD DEV =
STRATEGY 2 MEAN =
1.053 STD DEV =
STRATEGY 2 MEAN =
0.631 STD DEV =
STRATEGY 2 MEAN =
0.334 STD DEV =
STRATEGY 2 MEAN =
0.386 STD DEV =
STRATEGY 2 MEAN =
0.931 STD DEV =
STRATEGY 2 MEAN =
1.093 STD DEV =
STRATEGY 2 MEAN =
1.194 STD DEV =
STRATEGY 2 MEAN =
1.017 STD DEV =
STRATEGY 2 MEAN =
0.878 STD DEV =
0.854 STD DEV =

STRATEGY 3 MEAN =
4.636 STD DEV =
STRATEGY 3 MEAN =
0.218 STD DEV =
STRATEGY 3 MEAN =
7.629 STD DEV =
STRATEGY 3 MEAN =
0.773 STD DEV =
STRATEGY 3 MEAN =
0.530 STD DEV =
STRATEGY 3 MEAN =
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STRATEGY 3 MEAN =
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STRATEGY 3 MEAN =
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STRATEGY 3 MEAN =
0.0 STD DEV =
0.0 STD DEV =

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STRATEGY	1	MEAN =	3.755	STD DEV =	1.863	10362
STRATEGY	1	MEAN =	0.316	STD DEV =	0.588	10362
STRATEGY	1	MEAN =	-1.047	STD DEV =	0.543	10362
STRATEGY	1	MEAN =	-1.787	STD DEV =	0.220	10362
STRATEGY	1	MEAN =	-1.260	STD DEV =	0.151	10362
STRATEGY	1	MEAN =	-1.114	STD DEV =	0.184	10362
STRATEGY	1	MEAN =	-0.957	STD DEV =	0.159	10362
STRATEGY	1	MEAN =	-0.432	STD DEV =	0.242	10362
STRATEGY	1	MEAN =	0.201	STD DEV =	0.239	10362
STRATEGY	1	MEAN =	0.232	STD DEV =	0.087	10362
STRATEGY	1	MEAN =	0.348	STD DEV =	0.050	10362

STRATEGY	2	MEAN =	-18.305	STD DEV =	9.170	10362
STRATEGY	2	MEAN =	-1.281	STD DEV =	3.440	10362
STRATEGY	2	MEAN =	-1.017	STD DEV =	0.238	10362
STRATEGY	2	MEAN =	-0.421	STD DEV =	0.048	10362
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10362
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10362
STRATEGY	2	MEAN =	-0.174	STD DEV =	0.004	10362
STRATEGY	2	MEAN =	-0.141	STD DEV =	0.005	10362
STRATEGY	2	MEAN =	-0.144	STD DEV =	0.023	10362
STRATEGY	2	MEAN =	0.402	STD DEV =	0.313	10362
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10362
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10362

STRATEGY	3	MEAN =	-15.587	STD DEV =	13.973	10362
STRATEGY	3	MEAN =	-3.383	STD DEV =	1.605	10362
STRATEGY	3	MEAN =	-1.052	STD DEV =	0.272	10362
STRATEGY	3	MEAN =	23.217	STD DEV =	18.412	10362
STRATEGY	3	MEAN =	41.993	STD DEV =	46.265	10362
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10362
STRATEGY	3	MEAN =	167.651	STD DEV =	10.653	10362
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10362
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STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10362
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10362
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10362

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STRATEGY 1	MEAN =	-10.690	STD DEV =	2.863	10557
STRATEGY 1	MEAN =	-6.671	STD DEV =	1.986	10557
STRATEGY 1	MEAN =	-7.435	STD DEV =	0.711	10557
STRATEGY 1	MEAN =	-5.767	STD DEV =	0.618	10557
STRATEGY 1	MEAN =	-5.673	STD DEV =	0.568	10557
STRATEGY 1	MEAN =	-4.492	STD DEV =	0.317	10557
STRATEGY 1	MEAN =	-3.424	STD DEV =	0.394	10557
STRATEGY 1	MEAN =	-2.381	STD DEV =	0.448	10557
STRATEGY 1	MEAN =	-1.009	STD DEV =	0.353	10557
STRATEGY 1	MEAN =	0.058	STD DEV =	0.322	10557
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10557
STRATEGY 2	MEAN =	-25.756	STD DEV =	12.274	10557
STRATEGY 2	MEAN =	-4.730	STD DEV =	2.672	10557
STRATEGY 2	MEAN =	-1.319	STD DEV =	0.164	10557
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10557
STRATEGY 2	MEAN =	-0.526	STD DEV =	0.027	10557
STRATEGY 2	MEAN =	-1.387	STD DEV =	0.068	10557
STRATEGY 2	MEAN =	-0.717	STD DEV =	0.335	10557
STRATEGY 2	MEAN =	-0.271	STD DEV =	0.012	10557
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10557
STRATEGY 2	MEAN =	-0.192	STD DEV =	0.011	10557
STRATEGY 2	MEAN =	0.284	STD DEV =	0.189	10557
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10557
STRATEGY 3	MEAN =	-24.787	STD DEV =	14.329	10557
STRATEGY 3	MEAN =	4.639	STD DEV =	24.573	10557
STRATEGY 3	MEAN =	17.421	STD DEV =	22.499	10557
STRATEGY 3	MEAN =	222.708	STD DEV =	128.209	10557
STRATEGY 3	MEAN =	388.532	STD DEV =	153.728	10557
STRATEGY 3	MEAN =	155.449	STD DEV =	57.490	10557
STRATEGY 3	MEAN =	583.734	STD DEV =	110.695	10557
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STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10557
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10557
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10557
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10557

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STRATEGY 1	MEAN =	9.698	STD DEV =	4.058	10558
STRATEGY 1	MEAN =	2.906	STD DEV =	1.324	10558
STRATEGY 1	MEAN =	1.818	STD DEV =	0.761	10558
STRATEGY 1	MEAN =	3.667	STD DEV =	0.670	10558
STRATEGY 1	MEAN =	2.760	STD DEV =	0.351	10558
STRATEGY 1	MEAN =	0.610	STD DEV =	0.418	10558
STRATEGY 1	MEAN =	0.689	STD DEV =	0.197	10558
STRATEGY 1	MEAN =	0.454	STD DEV =	0.354	10558
STRATEGY 1	MEAN =	0.408	STD DEV =	0.400	10558
STRATEGY 1	MEAN =	0.769	STD DEV =	0.356	10558
STRATEGY 1	MEAN =	1.596	STD DEV =	0.123	10558
STRATEGY 2	MEAN =	-23.588	STD DEV =	17.219	10558
STRATEGY 2	MEAN =	-3.629	STD DEV =	5.954	10558
STRATEGY 2	MEAN =	-0.242	STD DEV =	2.324	10558
STRATEGY 2	MEAN =	-0.985	STD DEV =	0.042	10558
STRATEGY 2	MEAN =	4.145	STD DEV =	0.634	10558
STRATEGY 2	MEAN =	0.313	STD DEV =	1.809	10558
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10558
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STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10558
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10558
STRATEGY 2	MEAN =	1.570	STD DEV =	0.016	10558
STRATEGY 2	MEAN =	1.793	STD DEV =	0.042	10558
STRATEGY 3	MEAN =	-26.949	STD DEV =	15.412	10558
STRATEGY 3	MEAN =	-5.750	STD DEV =	3.825	10558
STRATEGY 3	MEAN =	-2.170	STD DEV =	1.228	10558
STRATEGY 3	MEAN =	-1.170	STD DEV =	0.015	10558
STRATEGY 3	MEAN =	-0.679	STD DEV =	0.217	10558
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10558
STRATEGY 3	MEAN =	-0.346	STD DEV =	0.032	10558
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10558
STRATEGY 3	MEAN =	-0.240	STD DEV =	0.002	10558
STRATEGY 3	MEAN =	-0.271	STD DEV =	0.002	10558
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10558
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10558

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STRATEGY	1	MEAN	=	-18.156	STD DEV	=	4.263	10559
STRATEGY	1	MEAN	=	-8.791	STD DEV	=	1.689	10559
STRATEGY	1	MEAN	=	-4.236	STD DEV	=	0.910	10559
STRATEGY	1	MEAN	=	-2.363	STD DEV	=	0.311	10559
STRATEGY	1	MEAN	=	-2.764	STD DEV	=	0.193	10559
STRATEGY	1	MEAN	=	-2.495	STD DEV	=	0.130	10559
STRATEGY	1	MEAN	=	-1.943	STD DEV	=	0.226	10559
STRATEGY	1	MEAN	=	-1.531	STD DEV	=	0.084	10559
STRATEGY	1	MEAN	=	-1.260	STD DEV	=	0.350	10559
STRATEGY	1	MEAN	=	-1.137	STD DEV	=	0.097	10559
STRATEGY	2	MEAN	=	-23.273	STD DEV	=	12.806	10559
STRATEGY	2	MEAN	=	-5.714	STD DEV	=	3.886	10559
STRATEGY	2	MEAN	=	-1.380	STD DEV	=	0.217	10559
STRATEGY	2	MEAN	=	-0.774	STD DEV	=	0.094	10559
STRATEGY	2	MEAN	=	-0.581	STD DEV	=	0.052	10559
STRATEGY	2	MEAN	=	-0.564	STD DEV	=	0.039	10559
STRATEGY	2	MEAN	=	-0.583	STD DEV	=	0.118	10559
STRATEGY	2	MEAN	=	-0.619	STD DEV	=	0.005	10559
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STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10559
STRATEGY	2	MEAN	=	-0.392	STD DEV	=	0.002	10559
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10559
STRATEGY	3	MEAN	=	-17.446	STD DEV	=	28.912	10559
STRATEGY	3	MEAN	=	21.213	STD DEV	=	65.725	10559
STRATEGY	3	MEAN	=	72.031	STD DEV	=	110.829	10559
STRATEGY	3	MEAN	=	-0.320	STD DEV	=	0.274	10559
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10559
STRATEGY	3	MEAN	=	-0.476	STD DEV	=	0.027	10559
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10559
STRATEGY	3	MEAN	=	-0.336	STD DEV	=	0.002	10559
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10559
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STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10559
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10559

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STRATEGY	1	MEAN =	-31.980	STD DEV =	12.624	10560
STRATEGY	1	MEAN =	-10.521	STD DEV =	2.162	10560
STRATEGY	1	MEAN =	-3.827	STD DEV =	0.707	10560
STRATEGY	1	MEAN =	-2.855	STD DEV =	0.392	10560
STRATEGY	1	MEAN =	-2.227	STD DEV =	0.291	10560
STRATEGY	1	MEAN =	-1.599	STD DEV =	0.163	10560
STRATEGY	1	MEAN =	-1.288	STD DEV =	0.216	10560
STRATEGY	1	MEAN =	-0.885	STD DEV =	0.111	10560
STRATEGY	1	MEAN =	-0.555	STD DEV =	0.187	10560
STRATEGY	1	MEAN =	-0.441	STD DEV =	0.075	10560
STRATEGY	1	MEAN =	-0.111	STD DEV =	0.081	10560
STRATEGY	2	MEAN =	-19.304	STD DEV =	10.218	10560
STRATEGY	2	MEAN =	-4.632	STD DEV =	2.040	10560
STRATEGY	2	MEAN =	-2.108	STD DEV =	1.297	10560
STRATEGY	2	MEAN =	-0.853	STD DEV =	0.074	10560
STRATEGY	2	MEAN =	-0.639	STD DEV =	0.017	10560
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10560
STRATEGY	2	MEAN =	-0.333	STD DEV =	0.016	10560
STRATEGY	2	MEAN =	-0.232	STD DEV =	0.004	10560
STRATEGY	2	MEAN =	-0.264	STD DEV =	0.005	10560
STRATEGY	2	MEAN =	-0.267	STD DEV =	0.044	10560
STRATEGY	2	MEAN =	-0.261	STD DEV =	0.039	10560
STRATEGY	2	MEAN =	-0.092	STD DEV =	0.027	10560
STRATEGY	3	MEAN =	-18.934	STD DEV =	11.859	10560
STRATEGY	3	MEAN =	7.993	STD DEV =	58.332	10560
STRATEGY	3	MEAN =	1.142	STD DEV =	5.716	10560
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STRATEGY	1	MEAN =	-5.663	STD DEV =	2.202	10561
STRATEGY	1	MEAN =	-10.197	STD DEV =	1.876	10561
STRATEGY	1	MEAN =	-10.796	STD DEV =	0.715	10561
STRATEGY	1	MEAN =	-8.587	STD DEV =	0.962	10561
STRATEGY	1	MEAN =	-5.257	STD DEV =	0.946	10561
STRATEGY	1	MEAN =	-3.378	STD DEV =	0.378	10561
STRATEGY	1	MEAN =	-2.219	STD DEV =	0.355	10561
STRATEGY	1	MEAN =	-1.663	STD DEV =	0.094	10561
STRATEGY	1	MEAN =	-1.273	STD DEV =	0.174	10561
STRATEGY	1	MEAN =	-1.059	STD DEV =	0.069	10561
STRATEGY	1	MEAN =	-1.030	STD DEV =	0.089	10561
STRATEGY	2	MEAN =	-20.234	STD DEV =	13.013	10561
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STRATEGY	2	MEAN =	-0.444	STD DEV =	0.033	10561
STRATEGY	2	MEAN =	-0.297	STD DEV =	0.004	10561
STRATEGY	2	MEAN =	-0.246	STD DEV =	0.017	10561
STRATEGY	2	MEAN =	-0.200	STD DEV =	0.038	10561
STRATEGY	2	MEAN =	-0.190	STD DEV =	0.021	10561
STRATEGY	2	MEAN =	-0.178	STD DEV =	0.013	10561
STRATEGY	2	MEAN =	-0.155	STD DEV =	0.000	10561
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STRATEGY	3	MEAN =	1.211	STD DEV =	11.220	10561
STRATEGY	3	MEAN =	202.031	STD DEV =	216.608	10561
STRATEGY	3	MEAN =	191.414	STD DEV =	132.563	10561
STRATEGY	3	MEAN =	387.824	STD DEV =	201.965	10561
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STRATEGY	1	MEAN =	1.137	STD DEV =	0.799	10562
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STRATEGY	1	MEAN =	-0.358	STD DEV =	0.762	10562
STRATEGY	1	MEAN =	-1.289	STD DEV =	0.102	10562
STRATEGY	1	MEAN =	-0.901	STD DEV =	0.164	10562
STRATEGY	1	MEAN =	-0.811	STD DEV =	0.182	10562
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STRATEGY	2	MEAN =	-14.019	STD DEV =	8.326	10562
STRATEGY	2	MEAN =	-1.383	STD DEV =	2.126	10562
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STRATEGY	2	MEAN =	-0.334	STD DEV =	0.002	10562
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STRATEGY	2	MEAN =	-0.167	STD DEV =	0.007	10562
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STRATEGY	3	MEAN =	-15.175	STD DEV =	7.432	10562
STRATEGY	3	MEAN =	-2.470	STD DEV =	1.912	10562
STRATEGY	3	MEAN =	2.610	STD DEV =	3.774	10562
STRATEGY	3	MEAN =	17.535	STD DEV =	11.030	10562
STRATEGY	3	MEAN =	25.824	STD DEV =	15.203	10562
STRATEGY	3	MEAN =	23.453	STD DEV =	3.685	10562
STRATEGY	3	MEAN =	98.157	STD DEV =	28.807	10562
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STRATEGY 1	MEAN =	-1.937	STD DEV =	1.579	10756
STRATEGY 1	MEAN =	-2.896	STD DEV =	1.175	10756
STRATEGY 1	MEAN =	-2.127	STD DEV =	1.487	10756
STRATEGY 1	MEAN =	0.997	STD DEV =	0.422	10756
STRATEGY 1	MEAN =	1.294	STD DEV =	0.319	10756
STRATEGY 1	MEAN =	1.425	STD DEV =	0.231	10756
STRATEGY 1	MEAN =	1.711	STD DEV =	0.160	10756
STRATEGY 1	MEAN =	1.564	STD DEV =	0.335	10756
STRATEGY 1	MEAN =	2.288	STD DEV =	0.330	10756
STRATEGY 1	MEAN =	2.167	STD DEV =	0.056	10756

STRATEGY 2	MEAN =	-29.133	STD DEV =	15.490	10756
STRATEGY 2	MEAN =	-5.635	STD DEV =	2.387	10756
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STRATEGY 2	MEAN =	0.536	STD DEV =	0.144	10756
STRATEGY 2	MEAN =	1.331	STD DEV =	0.276	10756
STRATEGY 2	MEAN =	1.622	STD DEV =	0.100	10756
STRATEGY 2	MEAN =	1.544	STD DEV =	0.139	10756
STRATEGY 2	MEAN =	1.829	STD DEV =	0.098	10756
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10756
STRATEGY 2	MEAN =	2.408	STD DEV =	0.266	10756
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10756

STRATEGY 3	MEAN =	-28.077	STD DEV =	14.069	10756
STRATEGY 3	MEAN =	3.241	STD DEV =	28.818	10756
STRATEGY 3	MEAN =	-1.804	STD DEV =	0.474	10756
STRATEGY 3	MEAN =	239.343	STD DEV =	13.102	10756
STRATEGY 3	MEAN =	231.994	STD DEV =	123.919	10756
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STRATEGY	1	MEAN =	8.753	STD DEV =	3.182	10757
STRATEGY	1	MEAN =	7.708	STD DEV =	2.828	10757
STRATEGY	1	MEAN =	2.814	STD DEV =	0.822	10757
STRATEGY	1	MEAN =	-0.136	STD DEV =	0.375	10757
STRATEGY	1	MEAN =	-2.198	STD DEV =	0.524	10757
STRATEGY	1	MEAN =	-2.339	STD DEV =	0.518	10757
STRATEGY	1	MEAN =	-2.011	STD DEV =	0.340	10757
STRATEGY	1	MEAN =	-1.915	STD DEV =	0.202	10757
STRATEGY	1	MEAN =	-1.457	STD DEV =	0.112	10757
STRATEGY	1	MEAN =	-0.722	STD DEV =	0.403	10757
STRATEGY	1	MEAN =	-0.089	STD DEV =	0.252	10757
STRATEGY	2	MEAN =	-23.418	STD DEV =	13.186	10757
STRATEGY	2	MEAN =	-1.471	STD DEV =	6.170	10757
STRATEGY	2	MEAN =	2.881	STD DEV =	6.132	10757
STRATEGY	2	MEAN =	-2.663	STD DEV =	0.033	10757
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10757
STRATEGY	2	MEAN =	-1.331	STD DEV =	0.063	10757
STRATEGY	2	MEAN =	-0.876	STD DEV =	0.182	10757
STRATEGY	2	MEAN =	-0.399	STD DEV =	0.014	10757
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STRATEGY	3	MEAN =	-2.536	STD DEV =	1.507	10757
STRATEGY	3	MEAN =	-0.771	STD DEV =	0.087	10757
STRATEGY	3	MEAN =	21.502	STD DEV =	23.098	10757
STRATEGY	3	MEAN =	125.523	STD DEV =	65.111	10757
STRATEGY	3	MEAN =	145.592	STD DEV =	82.684	10757
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STRATEGY	3	MEAN =	419.022	STD DEV =	21.391	10757
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STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10757

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STRATEGY 1	MEAN =	0.027	STD DEV =	0.525	10758
STRATEGY 1	MEAN =	-1.323	STD DEV =	0.283	10758
STRATEGY 1	MEAN =	-2.081	STD DEV =	0.272	10758
STRATEGY 1	MEAN =	-0.397	STD DEV =	0.488	10758
STRATEGY 1	MEAN =	-0.727	STD DEV =	0.507	10758
STRATEGY 1	MEAN =	-1.731	STD DEV =	0.196	10758
STRATEGY 1	MEAN =	-1.522	STD DEV =	0.183	10758
STRATEGY 1	MEAN =	-2.059	STD DEV =	0.170	10758
STRATEGY 1	MEAN =	-1.814	STD DEV =	0.115	10758
STRATEGY 2	MEAN =	-24.872	STD DEV =	13.023	10758
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STRATEGY 2	MEAN =	-0.896	STD DEV =	0.092	10758
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10758
STRATEGY 2	MEAN =	-0.602	STD DEV =	0.003	10758
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STRATEGY 3	MEAN =	-5.269	STD DEV =	2.138	10758
STRATEGY 3	MEAN =	-1.724	STD DEV =	0.519	10758
STRATEGY 3	MEAN =	-0.883	STD DEV =	0.132	10758
STRATEGY 3	MEAN =	-0.638	STD DEV =	0.108	10758
STRATEGY 3	MEAN =	193.029	STD DEV =	21.392	10758
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STRATEGY 3	MEAN =	107.691	STD DEV =	32.917	10758
STRATEGY 3	MEAN =	195.061	STD DEV =	65.886	10758
STRATEGY 3	MEAN =	279.981	STD DEV =	115.237	10758
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STRATEGY 1	MEAN =	0.671	STD DEV =	0.980	10759
STRATEGY 1	MEAN =	-0.323	STD DEV =	0.398	10759
STRATEGY 1	MEAN =	-0.487	STD DEV =	0.494	10759
STRATEGY 1	MEAN =	-0.292	STD DEV =	0.159	10759
STRATEGY 1	MEAN =	0.484	STD DEV =	0.234	10759
STRATEGY 1	MEAN =	0.428	STD DEV =	0.386	10759
STRATEGY 1	MEAN =	-0.014	STD DEV =	0.210	10759
STRATEGY 1	MEAN =	-0.023	STD DEV =	0.098	10759
STRATEGY 1	MEAN =	-0.036	STD DEV =	0.092	10759
STRATEGY 1	MEAN =	-0.116	STD DEV =	0.013	10759

STRATEGY 2	MEAN =	-17.965	STD DEV =	10.455	10759
STRATEGY 2	MEAN =	-4.410	STD DEV =	2.300	10759
STRATEGY 2	MEAN =	-0.680	STD DEV =	1.347	10759
STRATEGY 2	MEAN =	-0.824	STD DEV =	0.191	10759
STRATEGY 2	MEAN =	-0.550	STD DEV =	0.047	10759
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10759
STRATEGY 2	MEAN =	0.626	STD DEV =	0.141	10759
STRATEGY 2	MEAN =	0.849	STD DEV =	0.113	10759
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STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10759

STRATEGY 3	MEAN =	-19.980	STD DEV =	11.778	10759
STRATEGY 3	MEAN =	-3.823	STD DEV =	2.762	10759
STRATEGY 3	MEAN =	-1.294	STD DEV =	0.299	10759
STRATEGY 3	MEAN =	3.893	STD DEV =	13.204	10759
STRATEGY 3	MEAN =	20.099	STD DEV =	26.300	10759
STRATEGY 3	MEAN =	-0.365	STD DEV =	0.005	10759
STRATEGY 3	MEAN =	-0.402	STD DEV =	0.145	10759
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STRATEGY 1	MEAN =	-4.602	STD DEV =	0.617	10760
STRATEGY 1	MEAN =	-3.188	STD DEV =	0.397	10760
STRATEGY 1	MEAN =	-1.919	STD DEV =	0.182	10760
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STRATEGY 1	MEAN =	-0.768	STD DEV =	0.081	10760
STRATEGY 1	MEAN =	-0.506	STD DEV =	0.107	10760
STRATEGY 1	MEAN =	-0.588	STD DEV =	0.100	10760
STRATEGY 1	MEAN =	-0.567	STD DEV =	0.087	10760
STRATEGY 1	MEAN =	-0.176	STD DEV =	0.195	10760
STRATEGY 2	MEAN =	-14.434	STD DEV =	5.533	10760
STRATEGY 2	MEAN =	-3.956	STD DEV =	1.936	10760
STRATEGY 2	MEAN =	-1.525	STD DEV =	0.125	10760
STRATEGY 2	MEAN =	-0.972	STD DEV =	0.156	10760
STRATEGY 2	MEAN =	-0.717	STD DEV =	0.081	10760
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STRATEGY 2	MEAN =	-0.393	STD DEV =	0.102	10760
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STRATEGY 3	MEAN =	-1.971	STD DEV =	10.773	10760
STRATEGY 3	MEAN =	5.805	STD DEV =	12.394	10760
STRATEGY 3	MEAN =	1.537	STD DEV =	5.138	10760
STRATEGY 3	MEAN =	-0.670	STD DEV =	0.182	10760
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STRATEGY	1	MEAN =	3.761	STD DEV =	0.697	10761
STRATEGY	1	MEAN =	2.511	STD DEV =	0.422	10761
STRATEGY	1	MEAN =	0.800	STD DEV =	0.765	10761
STRATEGY	1	MEAN =	0.799	STD DEV =	0.343	10761
STRATEGY	1	MEAN =	1.663	STD DEV =	0.145	10761
STRATEGY	1	MEAN =	1.223	STD DEV =	0.306	10761
STRATEGY	1	MEAN =	1.238	STD DEV =	0.097	10761
STRATEGY	1	MEAN =	1.033	STD DEV =	0.115	10761
STRATEGY	1	MEAN =	0.814	STD DEV =	0.053	10761
STRATEGY	2	MEAN =	-17.105	STD DEV =	12.077	10761
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STRATEGY	2	MEAN =	2.863	STD DEV =	4.690	10761
STRATEGY	2	MEAN =	-1.185	STD DEV =	0.249	10761
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10761
STRATEGY	2	MEAN =	-0.255	STD DEV =	0.022	10761
STRATEGY	2	MEAN =	-0.200	STD DEV =	0.001	10761
STRATEGY	2	MEAN =	1.780	STD DEV =	0.060	10761
STRATEGY	2	MEAN =	1.735	STD DEV =	0.023	10761
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STRATEGY 1	MEAN =	0.249	STD DEV =	0.580	10762
STRATEGY 1	MEAN =	-0.216	STD DEV =	0.569	10762
STRATEGY 1	MEAN =	-0.691	STD DEV =	0.104	10762
STRATEGY 1	MEAN =	-0.585	STD DEV =	0.216	10762
STRATEGY 1	MEAN =	-0.516	STD DEV =	0.098	10762
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STRATEGY 2	MEAN =	-9.823	STD DEV =	8.423	10762
STRATEGY 2	MEAN =	-1.772	STD DEV =	1.978	10762
STRATEGY 2	MEAN =	-0.810	STD DEV =	1.133	10762
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STRATEGY 3	MEAN =	-2.118	STD DEV =	2.177	10762
STRATEGY 3	MEAN =	-0.105	STD DEV =	0.549	10762
STRATEGY 3	MEAN =	6.936	STD DEV =	12.505	10762
STRATEGY 3	MEAN =	17.076	STD DEV =	13.094	10762
STRATEGY 3	MEAN =	25.759	STD DEV =	47.105	10762
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STRATEGY	1	MEAN =	6.855	STD DEV =	1.739	10956
STRATEGY	1	MEAN =	7.147	STD DEV =	1.449	10956
STRATEGY	1	MEAN =	6.006	STD DEV =	0.847	10956
STRATEGY	1	MEAN =	3.483	STD DEV =	0.892	10956
STRATEGY	1	MEAN =	3.496	STD DEV =	1.058	10956
STRATEGY	1	MEAN =	4.152	STD DEV =	0.240	10956
STRATEGY	1	MEAN =	3.761	STD DEV =	0.265	10956
STRATEGY	1	MEAN =	3.717	STD DEV =	0.133	10956
STRATEGY	1	MEAN =	3.659	STD DEV =	0.176	10956
STRATEGY	1	MEAN =	3.230	STD DEV =	0.020	10956
STRATEGY	2	MEAN =	-24.664	STD DEV =	13.538	10956
STRATEGY	2	MEAN =	0.570	STD DEV =	8.996	10956
STRATEGY	2	MEAN =	8.830	STD DEV =	0.631	10956
STRATEGY	2	MEAN =	8.690	STD DEV =	0.387	10956
STRATEGY	2	MEAN =	6.930	STD DEV =	0.171	10956
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STRATEGY	2	MEAN =	4.643	STD DEV =	0.065	10956
STRATEGY	2	MEAN =	4.661	STD DEV =	0.002	10956
STRATEGY	2	MEAN =	3.993	STD DEV =	0.161	10956
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STRATEGY	2	MEAN =	3.712	STD DEV =	0.175	10956
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STRATEGY	3	MEAN =	-27.956	STD DEV =	14.480	10956
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STRATEGY	1	MEAN =	0.153	STD DEV =	0.310	10957
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STRATEGY	1	MEAN =	-1.724	STD DEV =	0.092	10957
STRATEGY	2	MEAN =	-24.151	STD DEV =	12.772	10957
STRATEGY	2	MEAN =	-4.469	STD DEV =	1.724	10957
STRATEGY	2	MEAN =	-1.385	STD DEV =	0.275	10957
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STRATEGY	2	MEAN =	1.661	STD DEV =	1.314	10957
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STRATEGY	3	MEAN =	-22.112	STD DEV =	12.993	10957
STRATEGY	3	MEAN =	3.712	STD DEV =	21.969	10957
STRATEGY	3	MEAN =	1.626	STD DEV =	11.102	10957
STRATEGY	3	MEAN =	-0.874	STD DEV =	0.073	10957
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STRATEGY	3	MEAN =	164.510	STD DEV =	78.752	10957
STRATEGY	3	MEAN =	133.240	STD DEV =	0.102	10957
STRATEGY	3	MEAN =	290.559	STD DEV =	157.805	10957
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STRATEGY 1	MEAN =	-0.968	STD DEV =	2.443	10959
STRATEGY 1	MEAN =	0.511	STD DEV =	0.388	10959
STRATEGY 1	MEAN =	-0.044	STD DEV =	0.362	10959
STRATEGY 1	MEAN =	0.759	STD DEV =	0.326	10959
STRATEGY 1	MEAN =	0.286	STD DEV =	0.240	10959
STRATEGY 1	MEAN =	0.197	STD DEV =	0.308	10959
STRATEGY 1	MEAN =	0.513	STD DEV =	0.194	10959
STRATEGY 1	MEAN =	0.932	STD DEV =	0.098	10959
STRATEGY 1	MEAN =	0.496	STD DEV =	0.253	10959
STRATEGY 1	MEAN =	0.242	STD DEV =	0.141	10959
STRATEGY 1	MEAN =	0.189	STD DEV =	0.067	10959

STRATEGY 2	MEAN =	-18.110	STD DEV =	8.954	10959
STRATEGY 2	MEAN =	-4.063	STD DEV =	2.376	10959
STRATEGY 2	MEAN =	-0.082	STD DEV =	1.103	10959
STRATEGY 2	MEAN =	-0.195	STD DEV =	1.074	10959
STRATEGY 2	MEAN =	0.827	STD DEV =	0.304	10959
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10959
STRATEGY 2	MEAN =	0.707	STD DEV =	0.101	10959
STRATEGY 2	MEAN =	0.643	STD DEV =	0.092	10959
STRATEGY 2	MEAN =	0.932	STD DEV =	0.098	10959
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10959
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10959
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10959

STRATEGY 3	MEAN =	-16.999	STD DEV =	10.503	10959
STRATEGY 3	MEAN =	-3.020	STD DEV =	5.152	10959
STRATEGY 3	MEAN =	-1.410	STD DEV =	0.270	10959
STRATEGY 3	MEAN =	1.139	STD DEV =	6.506	10959
STRATEGY 3	MEAN =	-0.552	STD DEV =	0.016	10959
STRATEGY 3	MEAN =	-0.414	STD DEV =	0.036	10959
STRATEGY 3	MEAN =	4.538	STD DEV =	5.983	10959
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10959
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10959
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10959
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10959
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10959

STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10960
STRATEGY 1	MEAN =	7.233	STD DEV =	2.434	10960
STRATEGY 1	MEAN =	3.788	STD DEV =	0.586	10960
STRATEGY 1	MEAN =	2.208	STD DEV =	0.633	10960
STRATEGY 1	MEAN =	0.415	STD DEV =	0.209	10960
STRATEGY 1	MEAN =	0.341	STD DEV =	0.190	10960
STRATEGY 1	MEAN =	0.621	STD DEV =	0.157	10960
STRATEGY 1	MEAN =	0.302	STD DEV =	0.106	10960
STRATEGY 1	MEAN =	0.428	STD DEV =	0.094	10960
STRATEGY 1	MEAN =	0.435	STD DEV =	0.077	10960
STRATEGY 1	MEAN =	0.452	STD DEV =	0.134	10960
STRATEGY 1	MEAN =	0.423	STD DEV =	0.155	10960

STRATEGY 2	MEAN =	-17.387	STD DEV =	6.826	10960
STRATEGY 2	MEAN =	-1.710	STD DEV =	5.708	10960
STRATEGY 2	MEAN =	1.530	STD DEV =	2.858	10960
STRATEGY 2	MEAN =	-0.746	STD DEV =	1.279	10960
STRATEGY 2	MEAN =	-0.840	STD DEV =	0.055	10960
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10960
STRATEGY 2	MEAN =	-0.471	STD DEV =	0.063	10960
STRATEGY 2	MEAN =	-0.322	STD DEV =	0.015	10960
STRATEGY 2	MEAN =	-0.280	STD DEV =	0.008	10960
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10960
STRATEGY 2	MEAN =	-0.265	STD DEV =	0.002	10960
STRATEGY 2	MEAN =	0.330	STD DEV =	0.484	10960

STRATEGY 3	MEAN =	-19.635	STD DEV =	11.310	10960
STRATEGY 3	MEAN =	-5.405	STD DEV =	2.429	10960
STRATEGY 3	MEAN =	-1.670	STD DEV =	0.314	10960
STRATEGY 3	MEAN =	-0.933	STD DEV =	0.242	10960
STRATEGY 3	MEAN =	-0.645	STD DEV =	0.073	10960
STRATEGY 3	MEAN =	-0.603	STD DEV =	0.079	10960
STRATEGY 3	MEAN =	-0.518	STD DEV =	0.023	10960
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10960
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10960
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10960
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10960
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10960

STRATEGY 1	MEAN =	1.913	STD DEV =	0.709	10961
STRATEGY 1	MEAN =	3.259	STD DEV =	2.401	10961
STRATEGY 1	MEAN =	1.982	STD DEV =	0.984	10961
STRATEGY 1	MEAN =	2.666	STD DEV =	0.696	10961
STRATEGY 1	MEAN =	3.137	STD DEV =	0.193	10961
STRATEGY 1	MEAN =	2.252	STD DEV =	0.201	10961
STRATEGY 1	MEAN =	1.657	STD DEV =	0.365	10961
STRATEGY 1	MEAN =	0.586	STD DEV =	0.317	10961
STRATEGY 1	MEAN =	1.121	STD DEV =	0.330	10961
STRATEGY 1	MEAN =	1.444	STD DEV =	0.081	10961
STRATEGY 1	MEAN =	1.034	STD DEV =	0.183	10961
STRATEGY 1	MEAN =	1.147	STD DEV =	0.040	10961

STRATEGY 2	MEAN =	-18.135	STD DEV =	10.413	10961
STRATEGY 2	MEAN =	-3.005	STD DEV =	3.693	10961
STRATEGY 2	MEAN =	0.223	STD DEV =	2.232	10961
STRATEGY 2	MEAN =	2.685	STD DEV =	2.037	10961
STRATEGY 2	MEAN =	3.213	STD DEV =	0.108	10961
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 2	MEAN =	1.533	STD DEV =	0.013	10961
STRATEGY 2	MEAN =	1.518	STD DEV =	0.037	10961
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10961

STRATEGY 3	MEAN =	-19.439	STD DEV =	10.675	10961
STRATEGY 3	MEAN =	-3.981	STD DEV =	2.019	10961
STRATEGY 3	MEAN =	-1.032	STD DEV =	0.304	10961
STRATEGY 3	MEAN =	-0.771	STD DEV =	0.033	10961
STRATEGY 3	MEAN =	-0.562	STD DEV =	0.004	10961
STRATEGY 3	MEAN =	-0.453	STD DEV =	0.003	10961
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 3	MEAN =	7.068	STD DEV =	6.354	10961
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10961
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10961

STRATEGY	1	MEAN =	3.588	STD DEV =	1.677	10962
STRATEGY	1	MEAN =	0.490	STD DEV =	0.414	10962
STRATEGY	1	MEAN =	0.108	STD DEV =	0.368	10962
STRATEGY	1	MEAN =	-0.102	STD DEV =	0.441	10962
STRATEGY	1	MEAN =	-0.491	STD DEV =	0.067	10962
STRATEGY	1	MEAN =	-0.430	STD DEV =	0.075	10962
STRATEGY	1	MEAN =	-0.367	STD DEV =	0.091	10962
STRATEGY	1	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	1	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	1	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	1	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	1	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	2	MEAN =	-5.918	STD DEV =	5.261	10962
STRATEGY	2	MEAN =	-1.198	STD DEV =	1.453	10962
STRATEGY	2	MEAN =	-0.246	STD DEV =	0.711	10962
STRATEGY	2	MEAN =	0.139	STD DEV =	0.562	10962
STRATEGY	2	MEAN =	-0.280	STD DEV =	0.009	10962
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	3	MEAN =	-7.326	STD DEV =	5.221	10962
STRATEGY	3	MEAN =	-1.555	STD DEV =	1.585	10962
STRATEGY	3	MEAN =	1.561	STD DEV =	1.665	10962
STRATEGY	3	MEAN =	7.761	STD DEV =	4.463	10962
STRATEGY	3	MEAN =	6.873	STD DEV =	5.139	10962
STRATEGY	3	MEAN =	1.625	STD DEV =	0.317	10962
STRATEGY	3	MEAN =	12.362	STD DEV =	8.037	10962
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10962
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10962

TABLE 2-B

RANDOM SELECTION STRATEGIES MARCH, 1968,
TO SEPTEMBER, 1969, OPTIONS

STRATEGY 1	MEAN =	-12.473	STD DEV =	6.370	10368
STRATEGY 1	MEAN =	-6.868	STD DEV =	3.529	10368
STRATEGY 1	MEAN =	-4.927	STD DEV =	1.165	10368
STRATEGY 1	MEAN =	-5.144	STD DEV =	0.334	10368
STRATEGY 1	MEAN =	-3.176	STD DEV =	0.559	10368
STRATEGY 1	MEAN =	-4.026	STD DEV =	0.550	10368
STRATEGY 1	MEAN =	-3.982	STD DEV =	0.685	10368
STRATEGY 1	MEAN =	-4.966	STD DEV =	0.385	10368
STRATEGY 1	MEAN =	-3.445	STD DEV =	2.538	10368
STRATEGY 1	MEAN =	-0.112	STD DEV =	0.154	10368
STRATEGY 1	MEAN =	-0.027	STD DEV =	0.085	10368
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 2	MEAN =	-24.014	STD DEV =	13.233	10368
STRATEGY 2	MEAN =	-4.821	STD DEV =	2.089	10368
STRATEGY 2	MEAN =	-1.259	STD DEV =	0.303	10368
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 2	MEAN =	-0.104	STD DEV =	0.123	10368
STRATEGY 2	MEAN =	0.158	STD DEV =	0.052	10368
STRATEGY 2	MEAN =	0.111	STD DEV =	0.034	10368
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 3	MEAN =	-23.016	STD DEV =	21.742	10368
STRATEGY 3	MEAN =	11.228	STD DEV =	29.953	10368
STRATEGY 3	MEAN =	44.456	STD DEV =	71.382	10368
STRATEGY 3	MEAN =	123.011	STD DEV =	70.226	10368
STRATEGY 3	MEAN =	154.842	STD DEV =	5.786	10368
STRATEGY 3	MEAN =	332.810	STD DEV =	107.121	10368
STRATEGY 3	MEAN =	487.374	STD DEV =	235.667	10368
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 3	MEAN =	730.576	STD DEV =	238.587	10368
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10368
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10368

STRATEGY 1	MEAN =	4.207	STD DEV =	5.699	10369
STRATEGY 1	MEAN =	3.226	STD DEV =	2.300	10369
STRATEGY 1	MEAN =	-0.045	STD DEV =	1.195	10369
STRATEGY 1	MEAN =	1.698	STD DEV =	0.573	10369
STRATEGY 1	MEAN =	1.777	STD DEV =	0.672	10369
STRATEGY 1	MEAN =	0.660	STD DEV =	0.402	10369
STRATEGY 1	MEAN =	-0.990	STD DEV =	0.256	10369
STRATEGY 1	MEAN =	-2.051	STD DEV =	0.271	10369
STRATEGY 1	MEAN =	-1.434	STD DEV =	0.716	10369
STRATEGY 1	MEAN =	-0.999	STD DEV =	0.001	10369
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 2	MEAN =	-22.078	STD DEV =	13.256	10369
STRATEGY 2	MEAN =	-3.040	STD DEV =	3.738	10369
STRATEGY 2	MEAN =	-0.783	STD DEV =	0.134	10369
STRATEGY 2	MEAN =	2.459	STD DEV =	0.167	10369
STRATEGY 2	MEAN =	1.029	STD DEV =	1.844	10369
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 3	MEAN =	-18.032	STD DEV =	9.334	10369
STRATEGY 3	MEAN =	-5.459	STD DEV =	3.273	10369
STRATEGY 3	MEAN =	12.078	STD DEV =	26.726	10369
STRATEGY 3	MEAN =	-1.074	STD DEV =	0.114	10369
STRATEGY 3	MEAN =	-0.655	STD DEV =	0.180	10369
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 3	MEAN =	46.176	STD DEV =	45.212	10369
STRATEGY 3	MEAN =	156.472	STD DEV =	105.680	10369
STRATEGY 3	MEAN =	154.070	STD DEV =	132.357	10369
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10369
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10369

STRATEGY	1	MEAN =	-8.773	STD	DEV =	9.004	10568
STRATEGY	1	MEAN =	-7.178	STD	DEV =	3.633	10568
STRATEGY	1	MEAN =	-4.199	STD	DEV =	1.334	10568
STRATEGY	1	MEAN =	-5.085	STD	DEV =	0.515	10568
STRATEGY	1	MEAN =	-3.372	STD	DEV =	1.247	10568
STRATEGY	1	MEAN =	-3.315	STD	DEV =	0.584	10568
STRATEGY	1	MEAN =	-3.613	STD	DEV =	0.384	10568
STRATEGY	1	MEAN =	0.010	STD	DEV =	3.390	10568
STRATEGY	1	MEAN =	1.536	STD	DEV =	0.755	10568
STRATEGY	1	MEAN =	-0.097	STD	DEV =	0.276	10568
STRATEGY	1	MEAN =	-0.081	STD	DEV =	0.094	10568
STRATEGY	1	MEAN =	-0.035	STD	DEV =	0.076	10568
STRATEGY	2	MEAN =	-26.810	STD	DEV =	15.334	10568
STRATEGY	2	MEAN =	-4.759	STD	DEV =	2.481	10568
STRATEGY	2	MEAN =	-1.664	STD	DEV =	0.344	10568
STRATEGY	2	MEAN =	-1.280	STD	DEV =	0.066	10568
STRATEGY	2	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	2	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	2	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	2	MEAN =	2.359	STD	DEV =	0.097	10568
STRATEGY	2	MEAN =	2.559	STD	DEV =	0.058	10568
STRATEGY	2	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	2	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	2	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	3	MEAN =	-24.096	STD	DEV =	19.238	10568
STRATEGY	3	MEAN =	4.498	STD	DEV =	24.790	10568
STRATEGY	3	MEAN =	41.240	STD	DEV =	84.721	10568
STRATEGY	3	MEAN =	72.780	STD	DEV =	99.490	10568
STRATEGY	3	MEAN =	125.091	STD	DEV =	59.271	10568
STRATEGY	3	MEAN =	387.919	STD	DEV =	36.122	10568
STRATEGY	3	MEAN =	391.129	STD	DEV =	168.029	10568
STRATEGY	3	MEAN =	555.985	STD	DEV =	221.744	10568
STRATEGY	3	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	3	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	3	MEAN =	0.0	STD	DEV =	0.0	10568
STRATEGY	3	MEAN =	0.0	STD	DEV =	0.0	10568

STRATEGY	1	MEAN	=	3.104	STD DEV	=	4.189	10569
STRATEGY	1	MEAN	=	1.763	STD DEV	=	1.335	10569
STRATEGY	1	MEAN	=	-0.541	STD DEV	=	1.016	10569
STRATEGY	1	MEAN	=	1.032	STD DEV	=	0.491	10569
STRATEGY	1	MEAN	=	1.400	STD DEV	=	0.407	10569
STRATEGY	1	MEAN	=	0.286	STD DEV	=	0.341	10569
STRATEGY	1	MEAN	=	-0.867	STD DEV	=	0.203	10569
STRATEGY	1	MEAN	=	-1.260	STD DEV	=	0.198	10569
STRATEGY	1	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	1	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	1	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	1	MEAN	=	0.0	STD DEV	=	0.0	10569

STRATEGY	2	MEAN	=	-15.752	STD DEV	=	8.178	10569
STRATEGY	2	MEAN	=	-2.736	STD DEV	=	2.889	10569
STRATEGY	2	MEAN	=	-0.675	STD DEV	=	0.074	10569
STRATEGY	2	MEAN	=	1.480	STD DEV	=	0.353	10569
STRATEGY	2	MEAN	=	2.021	STD DEV	=	0.204	10569
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	2	MEAN	=	0.0	STD DEV	=	0.0	10569

STRATEGY	3	MEAN	=	-13.610	STD DEV	=	7.277	10569
STRATEGY	3	MEAN	=	-3.036	STD DEV	=	2.409	10569
STRATEGY	3	MEAN	=	21.434	STD DEV	=	24.281	10569
STRATEGY	3	MEAN	=	-0.831	STD DEV	=	0.064	10569
STRATEGY	3	MEAN	=	-0.541	STD DEV	=	0.119	10569
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	3	MEAN	=	51.141	STD DEV	=	43.084	10569
STRATEGY	3	MEAN	=	84.794	STD DEV	=	45.063	10569
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10569
STRATEGY	3	MEAN	=	0.0	STD DEV	=	0.0	10569

STRATEGY 1	MEAN =	-14.224	STD DEV =	1.249	10768
STRATEGY 1	MEAN =	-7.540	STD DEV =	2.371	10768
STRATEGY 1	MEAN =	-4.282	STD DEV =	1.092	10768
STRATEGY 1	MEAN =	-4.430	STD DEV =	0.673	10768
STRATEGY 1	MEAN =	-3.145	STD DEV =	0.805	10768
STRATEGY 1	MEAN =	-3.120	STD DEV =	0.535	10768
STRATEGY 1	MEAN =	4.402	STD DEV =	0.753	10768
STRATEGY 1	MEAN =	2.085	STD DEV =	0.395	10768
STRATEGY 1	MEAN =	1.013	STD DEV =	0.682	10768
STRATEGY 1	MEAN =	-0.191	STD DEV =	0.244	10768
STRATEGY 1	MEAN =	-0.086	STD DEV =	0.083	10768
STRATEGY 1	MEAN =	-0.009	STD DEV =	0.086	10768

STRATEGY 2	MEAN =	-25.834	STD DEV =	13.724	10768
STRATEGY 2	MEAN =	-6.375	STD DEV =	3.853	10768
STRATEGY 2	MEAN =	-1.589	STD DEV =	0.330	10768
STRATEGY 2	MEAN =	-1.235	STD DEV =	0.172	10768
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 2	MEAN =	5.253	STD DEV =	0.192	10768
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10768

STRATEGY 3	MEAN =	-20.266	STD DEV =	12.719	10768
STRATEGY 3	MEAN =	3.255	STD DEV =	24.249	10768
STRATEGY 3	MEAN =	39.070	STD DEV =	82.014	10768
STRATEGY 3	MEAN =	5.339	STD DEV =	24.472	10768
STRATEGY 3	MEAN =	51.414	STD DEV =	95.711	10768
STRATEGY 3	MEAN =	189.134	STD DEV =	157.672	10768
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10768
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10768

STRATEGY 1	MEAN =	1.070	STD DEV =	1.341	10769
STRATEGY 1	MEAN =	-0.986	STD DEV =	1.058	10769
STRATEGY 1	MEAN =	-1.744	STD DEV =	0.533	10769
STRATEGY 1	MEAN =	-0.400	STD DEV =	0.636	10769
STRATEGY 1	MEAN =	0.454	STD DEV =	0.199	10769
STRATEGY 1	MEAN =	-0.177	STD DEV =	0.261	10769
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 2	MEAN =	-8.648	STD DEV =	6.095	10769
STRATEGY 2	MEAN =	-2.655	STD DEV =	1.105	10769
STRATEGY 2	MEAN =	-0.369	STD DEV =	0.010	10769
STRATEGY 2	MEAN =	0.370	STD DEV =	0.141	10769
STRATEGY 2	MEAN =	0.743	STD DEV =	0.097	10769
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 3	MEAN =	-8.782	STD DEV =	6.296	10769
STRATEGY 3	MEAN =	2.040	STD DEV =	9.502	10769
STRATEGY 3	MEAN =	13.855	STD DEV =	23.077	10769
STRATEGY 3	MEAN =	-0.565	STD DEV =	0.065	10769
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 3	MEAN =	24.428	STD DEV =	4.366	10769
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10769
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10769

STRATEGY	1	MEAN =	-5.763	STD DEV =	4.303	10968
STRATEGY	1	MEAN =	-7.008	STD DEV =	3.056	10968
STRATEGY	1	MEAN =	-4.141	STD DEV =	1.171	10968
STRATEGY	1	MEAN =	-2.378	STD DEV =	5.747	10968
STRATEGY	1	MEAN =	11.521	STD DEV =	1.376	10968
STRATEGY	1	MEAN =	8.109	STD DEV =	1.367	10968
STRATEGY	1	MEAN =	4.468	STD DEV =	0.676	10968
STRATEGY	1	MEAN =	2.024	STD DEV =	0.437	10968
STRATEGY	1	MEAN =	0.864	STD DEV =	0.540	10968
STRATEGY	1	MEAN =	-0.248	STD DEV =	0.308	10968
STRATEGY	1	MEAN =	-0.021	STD DEV =	0.065	10968
STRATEGY	1	MEAN =	0.019	STD DEV =	0.106	10968
STRATEGY	2	MEAN =	-28.025	STD DEV =	17.739	10968
STRATEGY	2	MEAN =	-6.838	STD DEV =	4.242	10968
STRATEGY	2	MEAN =	-2.953	STD DEV =	1.687	10968
STRATEGY	2	MEAN =	0.752	STD DEV =	5.468	10968
STRATEGY	2	MEAN =	13.732	STD DEV =	1.449	10968
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	2	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	3	MEAN =	-21.995	STD DEV =	13.471	10968
STRATEGY	3	MEAN =	1.701	STD DEV =	25.549	10968
STRATEGY	3	MEAN =	39.482	STD DEV =	66.387	10968
STRATEGY	3	MEAN =	6.300	STD DEV =	18.023	10968
STRATEGY	3	MEAN =	-0.876	STD DEV =	0.262	10968
STRATEGY	3	MEAN =	-0.859	STD DEV =	0.627	10968
STRATEGY	3	MEAN =	-1.225	STD DEV =	0.516	10968
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10968
STRATEGY	3	MEAN =	0.0	STD DEV =	0.0	10968

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STRATEGY 1	MEAN =	-0.358	STD DEV =	0.368	10969
STRATEGY 1	MEAN =	-0.883	STD DEV =	0.639	10969
STRATEGY 1	MEAN =	-0.872	STD DEV =	0.420	10969
STRATEGY 1	MEAN =	-0.183	STD DEV =	0.220	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 1	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	-5.115	STD DEV =	3.439	10969
STRATEGY 2	MEAN =	-0.894	STD DEV =	0.580	10969
STRATEGY 2	MEAN =	-0.260	STD DEV =	0.058	10969
STRATEGY 2	MEAN =	0.134	STD DEV =	0.049	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	-0.178	STD DEV =	72.442	10969
STRATEGY 3	MEAN =	7.579	STD DEV =	8.533	10969
STRATEGY 3	MEAN =	28.266	STD DEV =	15.112	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	10969

STRATEGY 1	MEAN =	50.190	STD DEV =	28.260	11268
STRATEGY 1	MEAN =	10.854	STD DEV =	8.576	11268
STRATEGY 1	MEAN =	3.546	STD DEV =	1.452	11268
STRATEGY 1	MEAN =	5.266	STD DEV =	0.427	11268
STRATEGY 1	MEAN =	3.034	STD DEV =	0.705	11268
STRATEGY 1	MEAN =	0.974	STD DEV =	0.841	11268
STRATEGY 1	MEAN =	-0.947	STD DEV =	0.293	11268
STRATEGY 1	MEAN =	-2.411	STD DEV =	0.226	11268
STRATEGY 1	MEAN =	-2.759	STD DEV =	0.475	11268
STRATEGY 1	MEAN =	-3.490	STD DEV =	0.417	11268
STRATEGY 1	MEAN =	-2.868	STD DEV =	0.121	11268
STRATEGY 1	MEAN =	-2.648	STD DEV =	0.123	11268
STRATEGY 2	MEAN =	-25.626	STD DEV =	22.209	11268
STRATEGY 2	MEAN =	-4.800	STD DEV =	7.074	11268
STRATEGY 2	MEAN =	0.134	STD DEV =	3.126	11268
STRATEGY 2	MEAN =	1.447	STD DEV =	3.247	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 2	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 3	MEAN =	-24.592	STD DEV =	14.132	11268
STRATEGY 3	MEAN =	-5.734	STD DEV =	3.542	11268
STRATEGY 3	MEAN =	-1.783	STD DEV =	0.269	11268
STRATEGY 3	MEAN =	-1.110	STD DEV =	0.137	11268
STRATEGY 3	MEAN =	-0.815	STD DEV =	0.127	11268
STRATEGY 3	MEAN =	22.173	STD DEV =	20.289	11268
STRATEGY 3	MEAN =	29.705	STD DEV =	45.353	11268
STRATEGY 3	MEAN =	96.548	STD DEV =	62.738	11268
STRATEGY 3	MEAN =	231.746	STD DEV =	173.081	11268
STRATEGY 3	MEAN =	225.407	STD DEV =	112.810	11268
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	11268
STRATEGY 3	MEAN =	0.0	STD DEV =	0.0	11268

TABLE 3-B

MEAN RATE OF RETURN FOR EACH OPTION 1957-1962

STRATEGY 1	MEAN RATE OF RETURN =	-18.232	3
STRATEGY 1	MEAN RATE OF RETURN =	-2.053	3
STRATEGY 1	MEAN RATE OF RETURN =	-0.775	3
STRATEGY 1	MEAN RATE OF RETURN =	-1.016	3
STRATEGY 1	MEAN RATE OF RETURN =	-0.992	3
STRATEGY 1	MEAN RATE OF RETURN =	-0.728	3
STRATEGY 1	MEAN RATE OF RETURN =	-0.029	3
STRATEGY 1	MEAN RATE OF RETURN =	0.213	3
STRATEGY 1	MEAN RATE OF RETURN =	0.617	3
STRATEGY 1	MEAN RATE OF RETURN =	0.869	3
STRATEGY 1	MEAN RATE OF RETURN =	0.650	3
STRATEGY 1	MEAN RATE OF RETURN =	0.452	3
STRATEGY 2	MEAN RATE OF RETURN =	-21.662	3
STRATEGY 2	MEAN RATE OF RETURN =	-2.838	3
STRATEGY 2	MEAN RATE OF RETURN =	-0.202	3
STRATEGY 2	MEAN RATE OF RETURN =	0.315	3
STRATEGY 2	MEAN RATE OF RETURN =	-0.334	3
STRATEGY 2	MEAN RATE OF RETURN =	-0.164	3
STRATEGY 2	MEAN RATE OF RETURN =	-0.145	3
STRATEGY 2	MEAN RATE OF RETURN =	0.487	3
STRATEGY 2	MEAN RATE OF RETURN =	0.803	3
STRATEGY 2	MEAN RATE OF RETURN =	0.869	3
STRATEGY 2	MEAN RATE OF RETURN =	0.340	3
STRATEGY 2	MEAN RATE OF RETURN =	0.142	3
STRATEGY 3	MEAN RATE OF RETURN =	-18.990	3
STRATEGY 3	MEAN RATE OF RETURN =	0.623	3
STRATEGY 3	MEAN RATE OF RETURN =	87.780	3
STRATEGY 3	MEAN RATE OF RETURN =	3.167	3
STRATEGY 3	MEAN RATE OF RETURN =	56.731	3
STRATEGY 3	MEAN RATE OF RETURN =	-0.022	3
STRATEGY 3	MEAN RATE OF RETURN =	41.967	3
STRATEGY 3	MEAN RATE OF RETURN =	13.987	3
STRATEGY 3	MEAN RATE OF RETURN =	0.0	3
STRATEGY 3	MEAN RATE OF RETURN =	0.0	3
STRATEGY 3	MEAN RATE OF RETURN =	0.0	3
STRATEGY 3	MEAN RATE OF RETURN =	0.0	3

STRATEGY 1	MEAN RATE OF RETURN =	-38.231	5
STRATEGY 1	MEAN RATE OF RETURN =	-9.694	5
STRATEGY 1	MEAN RATE OF RETURN =	-7.061	5
STRATEGY 1	MEAN RATE OF RETURN =	-4.898	5
STRATEGY 1	MEAN RATE OF RETURN =	-3.178	5
STRATEGY 1	MEAN RATE OF RETURN =	-2.277	5
STRATEGY 1	MEAN RATE OF RETURN =	-2.072	5
STRATEGY 1	MEAN RATE OF RETURN =	-1.579	5
STRATEGY 1	MEAN RATE OF RETURN =	-1.117	5
STRATEGY 1	MEAN RATE OF RETURN =	-0.649	5
STRATEGY 1	MEAN RATE OF RETURN =	-0.322	5
STRATEGY 1	MEAN RATE OF RETURN =	-0.114	5
STRATEGY 2	MEAN RATE OF RETURN =	-21.029	5
STRATEGY 2	MEAN RATE OF RETURN =	-4.277	5
STRATEGY 2	MEAN RATE OF RETURN =	-0.919	5
STRATEGY 2	MEAN RATE OF RETURN =	-0.631	5
STRATEGY 2	MEAN RATE OF RETURN =	0.270	5
STRATEGY 2	MEAN RATE OF RETURN =	-0.322	5
STRATEGY 2	MEAN RATE OF RETURN =	-0.341	5
STRATEGY 2	MEAN RATE OF RETURN =	-0.243	5
STRATEGY 2	MEAN RATE OF RETURN =	-0.076	5
STRATEGY 2	MEAN RATE OF RETURN =	-0.106	5
STRATEGY 2	MEAN RATE OF RETURN =	0.174	5
STRATEGY 2	MEAN RATE OF RETURN =	0.283	5
STRATEGY 3	MEAN RATE OF RETURN =	-20.143	5
STRATEGY 3	MEAN RATE OF RETURN =	4.473	5
STRATEGY 3	MEAN RATE OF RETURN =	48.844	5
STRATEGY 3	MEAN RATE OF RETURN =	71.611	5
STRATEGY 3	MEAN RATE OF RETURN =	133.583	5
STRATEGY 3	MEAN RATE OF RETURN =	29.738	5
STRATEGY 3	MEAN RATE OF RETURN =	113.591	5
STRATEGY 3	MEAN RATE OF RETURN =	-0.056	5
STRATEGY 3	MEAN RATE OF RETURN =	-0.040	5
STRATEGY 3	MEAN RATE OF RETURN =	-0.045	5
STRATEGY 3	MEAN RATE OF RETURN =	0.0	5
STRATEGY 3	MEAN RATE OF RETURN =	0.0	5

STRATEGY	1	MEAN RATE OF RETURN	=	-10.259	7
STRATEGY	1	MEAN RATE OF RETURN	=	0.936	7
STRATEGY	1	MEAN RATE OF RETURN	=	1.232	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.003	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.596	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.684	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.276	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.067	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.197	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.113	7
STRATEGY	1	MEAN RATE OF RETURN	=	-0.009	7
STRATEGY	1	MEAN RATE OF RETURN	=	0.112	7
STRATEGY	2	MEAN RATE OF RETURN	=	-19.536	7
STRATEGY	2	MEAN RATE OF RETURN	=	-3.345	7
STRATEGY	2	MEAN RATE OF RETURN	=	0.172	7
STRATEGY	2	MEAN RATE OF RETURN	=	-0.915	7
STRATEGY	2	MEAN RATE OF RETURN	=	-0.297	7
STRATEGY	2	MEAN RATE OF RETURN	=	-0.223	7
STRATEGY	2	MEAN RATE OF RETURN	=	-0.053	7
STRATEGY	2	MEAN RATE OF RETURN	=	0.483	7
STRATEGY	2	MEAN RATE OF RETURN	=	0.413	7
STRATEGY	2	MEAN RATE OF RETURN	=	0.0	7
STRATEGY	2	MEAN RATE OF RETURN	=	0.344	7
STRATEGY	2	MEAN RATE OF RETURN	=	-0.006	7
STRATEGY	3	MEAN RATE OF RETURN	=	-20.062	7
STRATEGY	3	MEAN RATE OF RETURN	=	-2.688	7
STRATEGY	3	MEAN RATE OF RETURN	=	-0.344	7
STRATEGY	3	MEAN RATE OF RETURN	=	35.607	7
STRATEGY	3	MEAN RATE OF RETURN	=	41.252	7
STRATEGY	3	MEAN RATE OF RETURN	=	51.517	7
STRATEGY	3	MEAN RATE OF RETURN	=	23.127	7
STRATEGY	3	MEAN RATE OF RETURN	=	0.308	7
STRATEGY	3	MEAN RATE OF RETURN	=	75.245	7
STRATEGY	3	MEAN RATE OF RETURN	=	27.866	7
STRATEGY	3	MEAN RATE OF RETURN	=	39.997	7
STRATEGY	3	MEAN RATE OF RETURN	=	0.0	7

STRATEGY 1	MEAN RATE OF RETURN =	-0.713	9
STRATEGY 1	MEAN RATE OF RETURN =	2.245	9
STRATEGY 1	MEAN RATE OF RETURN =	1.726	9
STRATEGY 1	MEAN RATE OF RETURN =	1.768	9
STRATEGY 1	MEAN RATE OF RETURN =	1.928	9
STRATEGY 1	MEAN RATE OF RETURN =	1.014	9
STRATEGY 1	MEAN RATE OF RETURN =	0.655	9
STRATEGY 1	MEAN RATE OF RETURN =	0.541	9
STRATEGY 1	MEAN RATE OF RETURN =	0.585	9
STRATEGY 1	MEAN RATE OF RETURN =	0.669	9
STRATEGY 1	MEAN RATE OF RETURN =	0.554	9
STRATEGY 1	MEAN RATE OF RETURN =	0.544	9

STRATEGY 2	MEAN RATE OF RETURN =	-18.061	9
STRATEGY 2	MEAN RATE OF RETURN =	-2.313	9
STRATEGY 2	MEAN RATE OF RETURN =	1.478	9
STRATEGY 2	MEAN RATE OF RETURN =	1.670	9
STRATEGY 2	MEAN RATE OF RETURN =	1.919	9
STRATEGY 2	MEAN RATE OF RETURN =	0.0	9
STRATEGY 2	MEAN RATE OF RETURN =	0.813	9
STRATEGY 2	MEAN RATE OF RETURN =	0.830	9
STRATEGY 2	MEAN RATE OF RETURN =	1.030	9
STRATEGY 2	MEAN RATE OF RETURN =	0.894	9
STRATEGY 2	MEAN RATE OF RETURN =	0.574	9
STRATEGY 2	MEAN RATE OF RETURN =	0.055	9

STRATEGY 3	MEAN RATE OF RETURN =	-18.911	9
STRATEGY 3	MEAN RATE OF RETURN =	-2.455	9
STRATEGY 3	MEAN RATE OF RETURN =	-0.394	9
STRATEGY 3	MEAN RATE OF RETURN =	0.913	9
STRATEGY 3	MEAN RATE OF RETURN =	0.746	9
STRATEGY 3	MEAN RATE OF RETURN =	0.026	9
STRATEGY 3	MEAN RATE OF RETURN =	30.149	9
STRATEGY 3	MEAN RATE OF RETURN =	23.385	9
STRATEGY 3	MEAN RATE OF RETURN =	48.427	9
STRATEGY 3	MEAN RATE OF RETURN =	0.0	9
STRATEGY 3	MEAN RATE OF RETURN =	0.0	9
STRATEGY 3	MEAN RATE OF RETURN =	0.0	9

APPENDIX C

EMPIRICAL DATA FOR PRIOR PROBABILITIES

This appendix presents the data used in establishing the prior probabilities. Tables 1-C, 2-C, 3-C, and 4-C are percentage distributions calculated from the frequencies of rates of return falling into each time period for the March, May, July, and September contracts respectively for the calendar years 1957-62. The same data is not presented for the 1967-68 calendar years by contract due to the small frequencies falling into each class. Instead, a summary of the frequencies over all contracts is presented in Table 6-C. Table 5-C is a frequency distribution summarizing the data on which Tables 1-C, 2-C, 3-C, and 4-C are based.

Table 7-C compares the posterior probability distributions from applying the exact Poisson computational formula and the normal approximation in calculating $P(A_i\ B)$ with $r = 35$, $t = 288$.

TABLE 1-C

PERCENTAGE DISTRIBUTION OF 14 CLASSES OF RATES OF RETURN
FOR 12 TIME PERIODS FOR ALL MARCH CONTRACTS 1957-1962

Rates of Return	Number of Days Contract Was Held											
	0-5	6-25	26-45	46-65	66-85	86-105	106-136	136-160	161-185	186-210	211-236	236-365
-10.0 or Lower	58.3	28.2	10.3	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.0 to -9.99	19.4	5.6	21.4	11.5	18.4	7.6	0.0	0.0	0.0	0.0	0.0	0.0
-2.0 to -4.99	0.0	1.6	5.1	10.6	4.3	8.4	16.5	0.0	0.0	0.0	0.0	0.0
-1.0 to -1.99	5.6	0.0	0.0	15.0	22.7	15.1	18.3	23.6	0.0	0.0	0.0	0.0
-0.5 to -0.99	0.0	1.6	0.0	6.2	19.1	10.1	7.3	23.6	6.2	0.0	0.0	0.0
-0.2 to -0.49	0.0	0.0	3.4	2.7	0.7	5.9	2.4	9.0	13.7	0.8	0.0	1.7
0.0 to -0.19	0.0	0.8	0.0	2.7	1.4	6.7	2.4	1.4	15.5	4.1	2.1	1.7
+0.01 to +0.19	0.0	0.0	0.9	2.7	4.3	8.4	2.4	0.0	4.3	8.3	9.9	10.2
+0.20 to +0.49	0.0	0.8	2.6	7.1	1.4	12.6	2.4	0.0	1.2	9.1	23.4	23.7
+0.50 to +0.99	0.0	1.6	1.7	11.5	8.5	1.7	22.0	6.9	16.8	43.8	49.6	62.7
+1.00 to +1.99	2.8	8.9	13.7	7.1	7.1	5.9	20.7	31.9	42.2	33.9	14.9	0.0
+2.00 to +4.99	0.0	18.5	16.2	10.6	12.1	17.6	5.5	3.5	0.0	0.0	0.0	0.0
+5.00 to +9.99	0.0	14.5	24.8	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+10.0 or Greater	13.9	17.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2-C

PERCENTAGE DISTRIBUTION OF 14 CLASSES OF RATES OF RETURN FOR 12 TIME PERIODS FOR ALL MAY CONTRACTS 1957-1962

Rates of Return	Number of Days Contract Was Held											
	0-5	6-25	26-45	46-65	66-85	86-105	106-136	136-160	161-185	186-210	211-236	236-365
-10.0 or Lower	55.2	42.5	28.1	23.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.0 to -9.99	13.8	12.4	29.6	31.1	36.0	24.1	1.0	0.0	0.0	0.0	0.0	0.0
-2.0 to -4.99	6.9	0.9	7.4	15.6	32.5	38.8	43.3	47.3	18.6	0.0	1.5	0.0
-1.0 to -1.99	0.0	1.8	0.0	7.4	14.0	11.2	17.5	20.0	29.0	33.8	33.1	36.6
-0.5 to -0.99	0.0	0.9	0.0	1.6	0.0	12.1	21.1	21.3	17.9	20.9	16.5	4.9
-0.2 to -0.49	0.0	0.0	3.0	1.6	0.0	0.0	2.1	0.0	6.2	14.2	17.3	2.4
0.0 to -0.19	0.0	0.9	2.2	0.8	0.0	0.0	0.0	0.0	0.7	7.4	3.8	36.6
+0.01 to +0.19	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	12.4	8.8	2.3	0.0
+0.20 to +0.49	0.0	1.8	9.6	4.1	0.0	0.0	8.2	3.3	6.2	6.8	6.0	0.0
+0.50 to +0.99	0.0	2.7	0.0	2.5	0.0	0.0	4.6	7.3	7.6	7.4	16.5	0.0
+1.00 to +1.99	0.0	14.2	3.7	5.7	0.0	0.0	2.1	0.7	1.4	0.7	3.0	19.5
+2.00 to +4.99	6.9	7.1	14.8	5.7	17.5	13.8	0.0	0.0	0.0	0.0	0.0	0.0
+5.00 to +9.99	6.9	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+10.0 or Greater	10.3	9.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 3-C

PERCENTAGE DISTRIBUTION OF 14 CLASSES OF RATES OF RETURN
FOR 12 TIME PERIODS FOR ALL JULY CONTRACTS 1957-62

Rate of Return	Number of Days Contract Was Held											
	0-5	6-25	26-45	46-65	66-85	86-105	106-136	136-160	161-185	186-210	211-236	236-365
-10.0 or Lower	50.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.0 to -9.99	7.5	16.5	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-2.0 to -4.99	5.0	8.7	17.3	19.4	13.2	19.5	7.5	5.7	3.9	0.0	10.6	1.0
-1.0 to -1.99	5.0	1.6	5.1	0.7	18.5	21.9	13.7	11.5	29.6	38.5	13.4	12.5
-0.5 to -0.99	0.0	2.4	5.1	24.5	29.1	12.5	15.8	25.3	5.3	15.6	8.5	0.0
-0.2 to -0.49	5.0	2.4	1.9	7.2	11.3	14.1	11.7	17.8	9.9	4.4	12.0	28.1
0.0 to -0.19	0.0	4.7	7.1	5.0	2.6	4.7	4.6	4.6	15.1	4.4	9.2	22.9
+0.01 to +0.19	0.0	3.1	8.3	5.0	4.0	0.0	4.6	2.3	1.3	5.2	7.0	8.3
+0.20 to +0.49	7.5	7.9	2.6	10.8	9.9	3.1	9.2	1.1	5.3	0.0	0.0	4.2
+0.50 to +0.99	0.0	7.9	6.4	2.9	0.7	7.8	17.1	4.6	5.3	0.0	7.0	11.5
+1.00 to +1.99	0.0	8.7	13.5	4.3	2.0	15.6	15.8	27.0	23.7	28.9	19.7	0.0
+2.00 to +4.99	12.5	3.1	7.7	20.1	8.6	0.8	0.0	0.0	0.7	3.0	12.7	11.5
+5.00 to +9.99	2.5	22.0	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+10.0 or Greater	5.0	7.1	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 4-C

PERCENTAGE DISTRIBUTION OF 14 CLASSES OF RATES OF RETURN
FOR 12 TIME PERIODS FOR ALL SEPTEMBER CONTRACTS 1957-62

Rate of Return	Number of Days Contract Was Held											
	0-5	6-25	26-45	46-65	66-85	86-105	106-136	136-160	161-185	186-210	211-236	236-365
-10.0 or Lower	16.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-5.0 to -9.99	4.0	14.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-2.0 to -4.99	12.0	2.1	8.3	2.8	0.0	0.0	6.6	19.2	22.0	15.5	20.8	0.0
-1.0 to -1.99	0.0	0.7	0.7	0.7	0.0	0.0	12.6	1.9	0.0	3.9	5.0	9.1
-0.5 to -0.99	0.0	1.4	0.7	7.8	12.8	3.1	3.8	0.0	0.0	0.0	0.0	0.0
-0.2 to -0.49	0.0	2.8	4.1	19.9	12.8	25.4	20.2	0.0	0.0	0.0	0.0	0.0
0.0 to -0.19	0.0	1.4	10.3	3.5	0.9	6.2	2.7	2.9	0.0	0.0	0.8	0.0
+0.01 to +0.19	0.0	4.2	11.7	9.9	2.6	5.4	2.7	4.8	0.0	1.9	7.5	6.4
+0.20 to +0.49	0.0	7.6	6.2	7.1	6.0	18.5	10.9	21.2	14.4	19.4	18.3	60.9
+0.50 to +0.99	0.0	10.4	13.1	5.7	13.7	6.9	10.9	24.0	27.1	8.7	16.7	14.5
+1.00 to +1.99	8.0	14.6	12.4	7.8	12.8	0.0	14.2	0.0	17.8	19.4	10.8	5.5
+2.00 to +4.99	52.0	7.6	20.7	17.7	27.4	33.1	15.3	26.0	18.6	31.1	20.0	3.6
+5.00 to +9.99	4.0	18.1	11.0	17.0	11.1	1.5	0.0	0.0	0.0	0.0	0.0	0.0
+10.0 or Greater	4.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 5-C

FREQUENCY DISTRIBUTION OF THE RATES OF RETURN FOR
THE MARCH, MAY, JULY, SEPTEMBER CONTRACTS
FOR THE CALENDAR YEARS 1956-62

Rates of Return	Number of Days Contract Was Held											
	0-5	6-25	26-45	46-65	66-85	86-105	106-136	136-160	161-185	186-210	211-236	236-365
-10.0 or Lower	61	91	50	33	0	0	0	0	0	0	0	0
-5.0 to -9.99	15	63	71	51	67	37	2	0	0	0	0	0
-2.0 to -4.99	7	17	55	62	63	80	141	101	59	16	42	1
-1.0 to -1.99	4	5	9	28	76	59	120	86	87	106	69	37
-0.5 to -0.99	0	8	9	54	86	46	98	110	44	52	34	2
-0.2 to -0.49	2	7	17	43	33	58	73	44	46	28	40	29
0.0 to -0.19	0	10	29	16	7	22	20	13	49	22	22	38
+0.01 to +0.19	0	10	33	24	15	17	20	9	27	32	36	21
+0.20 to +0.49	3	24	29	38	24	43	62	29	36	41	63	85
+0.50 to +0.99	0	30	31	28	29	21	106	54	78	73	122	64
+1.00 to +1.99	3	59	60	32	28	27	102	94	127	101	66	14
+2.00 to +4.99	20	46	81	72	82	81	37	32	23	36	42	15
+5.00 to +9.99	4	78	73	34	13	2	0	0	0	0	0	0
+10.0 or Greater	11	60	6	0	0	0	0	0	0	0	0	0

TABLE 6-C

FREQUENCY DISTRIBUTION OF THE RATES OF RETURN FOR ALL CONTRACTS IN THE CALENDAR YEARS 1967-68

Rates of Return	Number of Days Contract Was Held											
	0-5	6-25	26-45	46-65	66-85	86-105	106-136	136-160	161-185	186-210	211-236	236-365
-10.0 or Lower	15	14	0	0	0	0	0	0	0	0	0	0
-5.0 to -9.99	2	37	30	30	2	0	4	17	7	0	0	0
-2.0 to -4.99	2	34	88	55	60	66	50	69	31	21	28	10
-1.0 to -1.99	1	42	73	11	3	2	48	32	10	0	0	0
-0.5 to -0.99	17	26	36	5	0	7	71	1	3	11	0	0
-0.2 to -0.49	8	23	22	48	0	26	7	0	9	29	4	0
0.0 to -0.19	1	11	6	10	0	8	0	0	8	18	66	19
+0.01 to +0.19	7	12	1	23	5	27	0	0	5	24	20	10
+0.20 to +0.49	0	13	6	13	34	14	0	0	6	3	0	0
+0.50 to +0.99	0	5	8	17	24	27	0	0	15	0	0	0
+1.00 to +1.99	3	3	10	31	36	14	0	26	37	0	0	0
+2.00 to +4.99	9	34	12	14	30	3	43	35	10	0	0	0
+5.00 to +9.99	2	12	3	12	3	16	11	0	0	0	0	0
+10.0 or Greater	5	10	0	2	20	1	0	0	0	0	0	0

TABLE 7-C

COMPARISON OF THE POSTERIOR PROBABILITY FOR r=35, t=288
DETERMINED BY THE POISSON COMPUTATIONAL FORMULA
WITH THE NORMAL APPROXIMATION

Rate of Return	Prior	Conditional		Joint		Posterior	
		Poisson	Normal	Poisson	Normal	Poisson	Normal
-200 and Lower	.20	.00	.00	.00	.00	.00	.00
-50 to -199	.20	.007411	.00662	.001482	.001324	.078	.068
-49 to +49	.23	.066337	.06552	.015258	.01507	.804	.778
+50 to +199	.23	.009615	.0129	.0022114	.00297	.117	.154
+200 and Greater	.14	.000146	.00042	.0000204	.00000	.001	.000
				.0189718	.019364	1.000	1.000

APPENDIX D

COMMODITY DEFINITIONS

The terms defined in this appendix are peculiar to commodity trading and they are defined within the context of the commodity market.

Arbitrage - The simultaneous purchase and sale of the same commodity in different futures markets. The transaction occurs because of a price differential.

Buying In - Closing a position prior to delivery. Otherwise known as liquidating a position.

Calendar Year - The Julian Calendar.

Cash Commodity - The physical commodity as opposed to a "future."

Close 1 Price - The price of the last trade of the day (see Close 2 Price).

Close 2 Price - The price of the last trade if two trades occur almost simultaneously at different prices (sometimes referred to as split close).

Crop Year - The fiscal year for a commodity. Wheat's crop year is July 1 to July 1.

Distant Contracts - Sometimes referred to as deferred futures. An imprecise time expression referring to the futures which expire in a calendar month more than five months distant from the current period.

Delivery Month - The month in which the commodity is to be delivered. Usually synonymous with the option month.

Downside risk - A subjective probability estimate by an investor of the possible drop in value of an investment in a specified time period.

Future - A contract to be completed at a future date by delivery of the commodity.

Hedge - The sale (purchase) of a commodity futures contract which is offset by the ownership (sale) of a cash commodity.

Long - The purchase of an option. An agreement to pay a specified price upon receipt of the commodity on a specified future date.

Long Position - The speculator has more outstanding contracts calling for receipt of the commodity than he has for the future delivery of the commodity.

Margin - The cash deposit required on a futures contract as evidence of the investor's intent to fulfill the contract.

Near-Term Contracts - An imprecise time expression referring to the futures which expire within the next three calendar months from the current time period.

New Crop - The commodity to be produced from the next crop.

Old Crop - The commodity produced from the current crop or some preceding year.

Open Contract - A contract which has not been completed either by delivery of the commodity, sale, or repurchase of the contract, or by receipt of the commodity.

Open Interest - The actual quantity (number) of unliquidated contracts.

Option - The right to sell (purchase) a specified commodity at a specified price on or before a specified date.

Outstanding Contracts - A contract which has not been closed out (see Open Contracts).

Position - The speculator's open contracts (net short or long position).

Short Sale - The sale of a specified commodity for later delivery. The seller might or might not own the cash commodity.

Speculator - A party to a futures contract. Used synonymously with the term investor in the text.

Stop-Loss - An order placed below the current market price which automatically becomes a market order when the market price of the commodity falls to the stop-loss order point.

Straddle - A speculator has taken two positions: (1) a short position in one delivery month, and (2) a long position in another delivery month. Sometimes, one of the positions is taken in another commodity which has a similar price movement.

Striking Price - The price at which the transaction occurred.

Volume - The total number of futures transactions for a specified period.

VITA

Brent Blake Dalrymple was born March 7, 1937, in Baton Rouge, Louisiana. He received his primary education in New Orleans, Louisiana through the public school system and graduated from Alcee Fortier High School in June, 1954.

He attended Louisiana State University and Tulane University before receiving a Bachelor of Arts degree from Northwestern State College, Natchitoches, Louisiana, with a major in History in January, 1960. After working in the education field for a short period, he enrolled as a Psychology major at Louisiana State University in New Orleans and received a Bachelor of Arts degree as a member of that institution's first graduating class in June, 1962.

As a College Representative for a major textbook publisher his interest in a career in college teaching intensified and subsequently he enrolled in the Master of Business Administration Program at Louisiana State University in September, 1964. He was awarded the Master of Business Administration degree in May, 1966, and is now a candidate for the degree of Doctor of Philosophy with a major in Finance and minors in Statistics and Accounting. Currently, the candidate is an Assistant Professor of Business at Florida Atlantic University, Boca Raton, Florida, and plans to continue his career in college teaching.

EXAMINATION AND THESIS REPORT

Candidate: Brent Blake Dalrymple

Major Field: Business Finance

Title of Thesis: Risk Analysis Applied to Commodity Speculation

Approved:

Donald E. Vaughn
Major Professor and Chairman

Max Goodrich
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Date of Examination:

July 20, 1970